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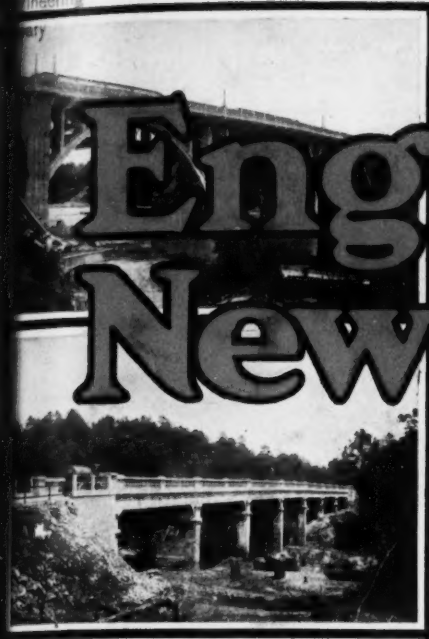
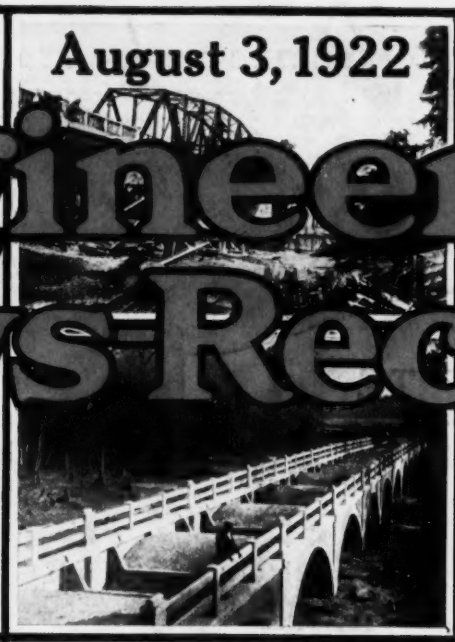
August 3, 1922

Engineering News-Record





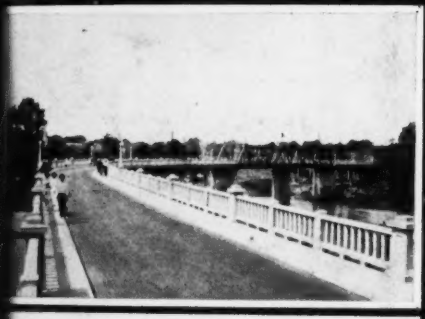
Different Types of Bridges Built by the Georgia State Highway Department

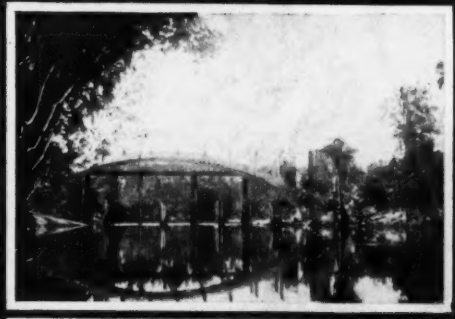
Georgia Highway Bridge Practice

New Studies of Stress Distribution

Concrete Block in a Shield Tunnel

Monthly Labor and Material Prices





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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, AUGUST 3, 1922 — Number 5

Brooklyn Bridge Again

DURING the past week the Brooklyn Bridge once more became subject to wide press notice because of official cognizance of a recent slipping in the cables and a subsequent, though not necessarily consequent, official suggestion for another East River bridge. The structural facts in the case are noted in the news pages of this issue. Nothing has happened that makes necessary any revision of the editorial in our issue of July 13, p. 47, which stated that the bridge is in no immediate danger.

Rain Curtails Road Construction

CURTAILED production of paved road because of excessive rain in many eastern states is arousing concern. With mileages of new pavement under contract which equal or exceed those of any previous year some large roadbuilding states expect to see a smaller mileage completed than during 1920 or 1921 unless weather conditions quickly improve and continue good well into the fall months. In Pennsylvania the highway department reports that of 82 working days up to July 22, there has been rain in 34 days. While doubtless on many of these days there were showers only, it is equally probably that on other days the rain was heavy enough to put the subgrade in a condition impracticable to work for one or more days following. Altogether it is not extravagant to conclude that in Pennsylvania one-half of the roadbuilding season up to July 22 has been lost on account of rain and mud delays. Other states will show different records as their weather conditions have been different, but none will fail to show a considerable lost road-construction time because of wet weather. To assign any specific economic loss because of these delays is mere speculation without more complete records than are at hand but no one will dispute that it is large. The question naturally follows: Why should we endure this loss? Is it beyond construction engineering skill to devise methods of carrying on road construction which will not be upset by every summer shower? This is a problem which engineers and contractors have to solve if they are to justify their right to leadership in the construction industry.

Representative Opinion

A MEASURE of the responsibility imposed upon the Federated American Engineering Societies may be gained from the published report of the recent meeting of its Committee on Procedure, noted in the news pages of this issue. That committee, composed of several of the country's leading engineers, among other things petitioned the President to go slow in any action regarding the German dye patents controlled by the Chemical Foundation which the President has ordered returned to the Alien Property Custodian. This action has been seized upon by the public press as indicative of an attitude of the engineers of the country against the Department of Justice and in favor of the Chemical Foundation in the highly controversial issue of the dye patents. This view is fostered particularly because the reports of the resolution were accompanied by a statement of Dean Cooley that the federation "speaks concerning national problems . . . on behalf of some 55,000 engineers." The fact is that while some few engineers, among whom are doubtless some of the Committee on Procedure, are qualified to pass judgment on the case, probably not 10 per cent of the profession know anything about it, or could be persuaded to give an opinion if asked. Just how far is a committee of a council of representatives authorized to pledge the many who elect the representatives?

Nibbling at the Water Power Act

TO THOSE who have watched the long fight to enact a federal water-power law which would aid the development of navigable and federal streams the disregard by the Ford offer for Muscle Shoals of the provisions of the law finally enacted was the most serious fault of that much advertised offer. It seemed to be the camel's nose under the tent, the forerunner of many attempts to make exceptions to the general rule. This is proving to be the fact. From Washington come authentic reports that every effort is being made to remove the proposed St. Lawrence project, if ever approved, from the provisions of the act; the Swing-Johnson bill for the development of the Colorado places that water power under the jurisdiction of the Secretary of the Interior. These are the three biggest water-power prospects in the country. Evidently the water-power act is expected to apply only to the little fellows too weak to fight or to control legislation. Such an outcome would make a joke of the act.

Demos and Garbage Disposal

ONE of the arguments in favor of garbage disposal by incineration rather than by reduction or by hog feeding is that incineration makes possible the material shortening of garbage haul because several incinerators can be provided in well planned garbage collection districts, whereas with either of the other two mentioned garbage disposal methods the disposal plant must be located at the outskirts of the city or even beyond the city limits. Theoretically this is correct but as a matter of practice, in American cities at least, it is a mistaken notion. Within a year Philadelphia changed a garbage disposal project from several incinerators to a single one and then, through the action of city counsel after local objection, hastily abandoned the site chosen for the one plant—where the project seems to have rested for months. Recently the administrative officials of Toledo, Ohio, decided upon garbage disposal

by incineration in accordance with this same theory of shortened haul by the provision of several incinerators. The site chosen for the first of these incinerators caused such opposition that it was speedily abandoned. Experience with garbage incineration at Toronto seems to have played a part in deciding on the adoption of incineration for Toledo; but when Toronto, very recently, proposed to build another incinerator the strong opposition to the site, as voiced at a public meeting, led one of the city officials to declare, according to the Toronto *Globe* of July 19: "The will of the people must be respected. We are living in an age of democracy, and when the people say they don't want a thing, it should not be forced upon them." It appears that Demos has not been sufficiently considered in urging the superiority of garbage incineration over reduction or hog feeding.

Hooch Refuse Disposal

ENGINEERS—as engineers—might reasonably have expected to have little interest in the Eighteenth Amendment. As members of the human race, they are subject to all that race's well-known frailities and desires, but to them as a profession the alcoholic content of a beverage would seem to be a matter of the slightest consequence. But prohibition, it seems, has a universal reaction, for we read that the sewer inspector of North Tarrytown, N. Y., has been compelled to beseech by public proclamation the good citizens of his town to refrain from throwing the refuse from their private—and illicit—stills into the sewers. Grain, mash, prune pits, and like discards have clogged and choked the pipes to the necessity for repair, and realizing the absurdity of requesting a law governing or even restricting the performance of an illegal act, the inspector falls back on good-natured appeal. Sooner or later the home brewer and distiller must have his own disposal plant, or at least some nomenclature committee may have to decide whether hooch refuse is sewage or garbage.

A National Conspiracy

PRESIDENT HARDING has put his finger on the crux of the coal strike when he intimates that peace would have been here long since had not the United Mine Workers been hostile to district or state agreements between operators and miners. He significantly suggests that every state legislature and Congress itself would have put an end instantly to the arrangement if the coal producers as a national body had attempted to determine the policy of every member and permit no sales of coal except on terms dictated by the national officials. The United Mine Workers, however, assumed national dictation and have prevented district groups from settling with the operators. In the anthracite region, for example, only the question of wages was at issue. That would probably have been compromised long since had it not been for the pressure of the union. The President says he will submit the whole matter to Congress after the House reassembles. We believe that he should. To us it seems conspiracy as iniquitous as would be a national price fixing scheme by the operators. It will be interesting to learn whether the people, as represented by their members in Congress, take the same view as the President. If the facts are before them we have no fear of the verdict. How it may be translated into legislation is another—and a very difficult—matter.

Rail Priorities and Road Work

IT IS still too early to predict the general effect on state-highway-construction programs of such emergency orders, growing out of the coal and the railway strikes, as the Interstate Commerce Commission may issue to cover priorities on rail shipments. In those states where road-building materials are obtained largely from local sources or where the lower types of construction, such as earth or sand-clay, are prevalent, the situation will not be serious. Elsewhere, however, a more critical condition threatens, as is indicated by the comment of state highway officials in this week's news pages. The reports from Texas, California, New York, Pennsylvania, Maryland and Kansas, for example, forecast a marked slowing down of road-building activities if priority orders are rigidly enforced. Few contractors have sufficient stocks of stone, cement or bituminous materials on hand to tide them over any considerable period of discontinued railway service. The coal shortage also is making itself felt at the cement mills, and unless the situation improves the Portland Cement Association believes, according to a statement issued last week, that a number of mills must soon shut down. All of this occurs just when the road-building season is at its height. Coupled with the unusually great number of rainy days this season a crippling of rail transport serivce for highway materials at this time would effectively reduce the estimate of over $700,000,000 as the probable volume of this year's highway work outside of cities.

Twenty Years of Reclamation

ON the twentieth anniversary of the reclamation act, June 17 last, the secretary of the interior sent out a heartening message of interest to engineers as well as to the people on the various projects and in the Reclamation Service. Reclamation by irrigation, the secretary said, is worth while for the nation as a whole. There is no longer question as to the ability of federal engineers to plan and construct efficiently the monumental works required. Compact and contented communities have been established. The success of the adventure is measured by the extent to which the reclaimed lands are utilized in the making of self-supporting American homes and not by the accomplishments of engineers in constructing great hydraulic works.

Twenty years after the act was signed there are still problems; possibly President Roosevelt's dreams have not all materialized, but the optimistic reports from every one of the projects by bona fide water users as given in the June *Reclamation Record*, followed by the imposing array of statistics in tables and diagram form can lead to but one conclusion; the investment was sound. Of the total $135,000,000 fund $106,000,000 came from the sale of public land. The $20,000,000 advanced by the treasury department is being repaid at the rate of $1,000,000 a year. Collections totaling $41,000,000 do not increase the investment but constitute a working capital. Since 1921 a certain portion of royalties on oil and potassium leases on public lands totaling $7,600,000, has been credited to the fund.

Against this debit side of the ledger are the following facts: Crops in 1922 will be produced on 1,200,000 acres by government water and will be valued at $53,000,000. The aggregate value of the crops since

the beginning including 1921 is approximately $475,000,000 as compared with the net construction cost of $129,000,000. Gradually the investment is being returned in increasing amounts.

Many times have politicians in the East said that the cost never would be returned so it must be gratifying to reclamation officials to read the boasts of several projects to the effect that not a settler ever has defaulted. Secretary Fall says he believes the majority of irrigation settlers will meet their obligations when due. From the economic as well as social viewpoint the engineer may look on this work, primarily of his conception, as a decidedly helpful factor in the upbuilding of the nation. His works are useful and used.

The Crisis in Coal

AS THIS is written (Monday morning) there is promise of an early settlement of the railway shopmen's strike. But peace in the coal industry seems as far removed as every. Some settlement of the latter controversy must come soon; we are in the crisis stage. The public is beginning to appreciate the situation, and public ire is sure to mount rapidly in the next few weeks. Stoppage of industry is imminent; cold houses are foreshadowed for next winter.

The beginning of the coal strike was witnessed by the public with remarkable complacency. The winter was over, and the daily press heralded widely the Geological Survey's report of the large amount of bituminous coal (67,000,000 tons) on hand. But the stocks have dwindled to the panic point; on July 1 only 20,000,000 tons were left. The amount is much smaller now. The production of the non-union fields was expected to save the situation. It did rise to a maximum of 5,600,000 tons per week—against a consumption of 8,000,000 tons. But the railway shopmen's strike—apparently with special pressure put on the non-union mine area—cut the production week before last to 3,600,000 tons, on account of the failure to move the cars actually loaded. With the coal-moving priority in effect on the railroads, the production last week jumped to over 4,000,000 tons and will probably go back to the maximum. Had it stayed at the minimum the plight of industry would at once have been serious. The railroads and other public utilities burn 3,250,000 tons per week. The margin for industry would have been extremely small.

But even with the non-union mines at maximum capacity the prospect is serious. The railroads and utilities need not worry. They will get coal under the priorities. Industry must continue to draw on its stocks, which, even when augmented by the margin of non-union production above the needs of the utilities, will not last over four weeks at the maximum. Some districts have larger stocks than others; New England, for example, probably can run its industries for two months or more. In other districts supplies are below the four-weeks average. The priorities will help much, but there is no blinking the fact that the situation for industry is serious. The reports of shutdowns on account of coal shortage are already coming in.

In anthracite conditions are even worse than in bituminous coal. When the strike is finally called off the bituminous mines with their great over-capacity will be able quickly to build up stocks. But the anthracite industry has no over-capacity. It works 12 months in the year to supply fuel for the 7 months of use. The stocks are negligible. Four-months production has already been lost. Coal control even for bituminous coal will probably continue until well on into the winter; anthracite control will be absolutely necessary in order to secure equitable distribution and freedom from suffering.

From this brief review the critical juncture which the strike has reached is apparent. The public is beginning to sense the situation—which foreshadows settlement. Until now it has been complacent. It felt certain that it would not be pinched. Now it foresees loss of employment—through industrial stoppage—and an uncomfortable winter. Soon it will begin its rumblings; then will the disputants realize that they must come to terms. Lewis, the miners' leader, senses the rising storm. Last week he predicted peace within a month. Certainly under the pressure of the government, backed by a growing public demand for settlement the production of coal somehow cannot long be deferred.

Water Purification Sweeps On

ONE by one the cities on the Mississippi and Missouri and the Great Lakes not already provided with complete water purification works are taking rapid steps to that desirable end. Omaha, through the Metropolitan Utilities District, has begun construction of a 50,000,000-gal. filter plant, as noted elsewhere in this issue. Kansas City voters approved an $11,000,000 bond issue April 4, which will provide filtration and other improvements. Buffalo and Detroit are at work on water filters. Milwaukee, due to political and professional strife, is deadlocked on carrying out filter plans advised by experts after careful investigation. Chicago is the only large city taking water from the Great Lakes or from the Mississippi and Missouri—to which the Ohio River may be added—which has made no move for water filtration. It is only a question of time before it will do so. The reasons for its inaction were discussed in these columns, April 28, 1921, p. 707. One of these reasons is that excessive water waste should first be cut out. Another is that the heavy fall in typhoid at Chicago to a very low figure has begot confidence in the safety of the water supply.

It has been the increasingly urgent demand for clear, sparkling, colorless, odorless, tasteless, and soft water in place of supplies lacking one or more of these qualities that has been a large and sometimes the major factor in the adoption of complete purification works by many of the cities just passed in review. In fact, it was mud rather than typhoid that led Omaha and other Missouri and Mississippi River cities to adopt sedimentation many years ago and later to add coagulation. And it has been mud or color rather than typhoid that has spurred hundreds of cities to build mechanical filtration plants.

The time has now come when all the available agencies of water treatment—coagulation, sedimentation, filtration, and chlorination—or as many of them as are needed to ensure a water supply ideal in character—should be adopted by every city dependent on a surface supply. The most expensive of these combinations adds comparatively little to the cost of water and leaves water supplies still by far the cheapest public utility in the field, considering its many functions and their vital character as regards life and property.

Driving a Concrete-Block Sewer Tunnel by Shield: Some Troubles and Their Remedies

A Record of Experience in Water-Bearing Sand at Flushing — Traveling Platform for Supporting Leading Ring — New Equipment Sets Blocks Accurately to Place in First Operation

By John F. O'Rourke
O'Rourke Engineering Construction Co., New York City

An 87-in. shield-driven interlocking-concrete-block tunnel at Flushing, L. I., built last year for the city of New York, is the first tunnel of that description constructed under the supervision of the writer. This tunnel, 1,922 ft. long, passed through sand, clay and hardpan at depths varying from 25 to 60 ft. below street and 15 to 50 ft. below groundwater, and was driven without use of compressed air, though much pumping was required. In this experience the concrete-block type of tunnel proved highly successful both in execution and in the finished product, but some faults were discovered in the apparatus and procedure used, whose elimination is important if the most advantageous application of concrete blocks is to be realized. The troubles encountered and how to eliminate them on similar work hereafter, with suggestions for improving tunneling generally, form the subject of this article.

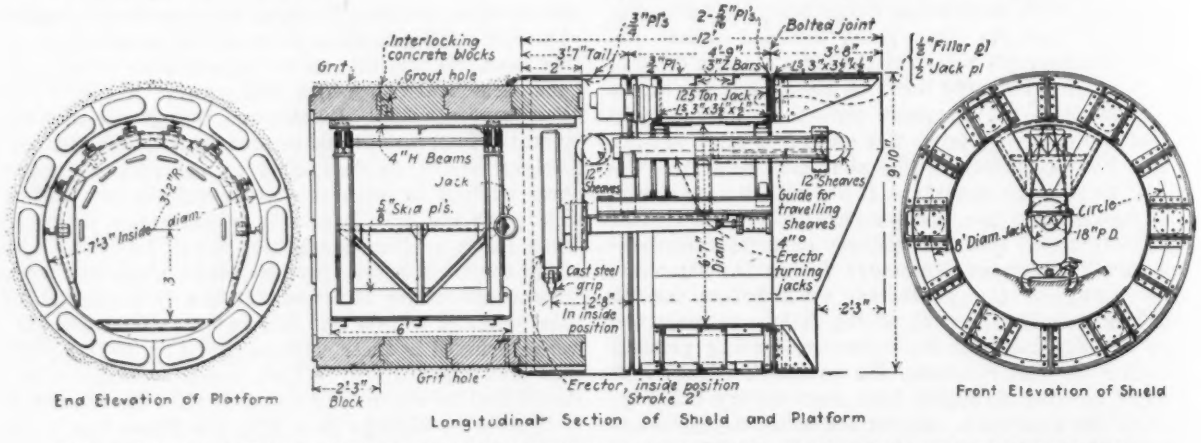


FIG. 1. SHIELD AND PLATFORM OF FLUSHING SEWER TUNNEL DESIGNED FOR CONCRETE-BLOCK SETTING

The distinguishing feature of the equipment used at Flushing was a platform carrying movable H-bars (Fig. 3), forming traveling support for the leading ring of blocks. This platform, as well as the shield and erector, was designed with the best knowledge then possessed by the writer of the problems and difficulties involved. The shield itself was built similar to those used heretofore in cast-iron lined tunnels, and there were no troubles encountered with it. The erector, which was fitted with a rigid tongs-shaped grip, proved inadequate, however.

While it held the block with strength and firmness, the erector commonly failed to hold it exactly in line with the arc of the tunnel or in the plane of the ring, so that it was usually necessary to land the block on the movable H-bars and adjust it into position with crowbars, before it could be shoved into place with the shield jacks. In connection with this operation, also, the H-bar arrangement was defective, in that the outward motion of the bars towards the tunnel shell was restricted to the play afforded by the Z-bar guides in which they were held, which play was usually insufficient to allow them to come into contact with the rings. For this reason it was generally necessary to put packing on top of the H-bars in order to hold the block in position. Thus considerable time was lost in setting the blocks, and as the bars were seldom in contact with the interior surface of the tunnel they could not be clamped against the rings while shoving the shield.

In spite of these handicaps the tunnel was driven an average of 11½ ft. a day from the commencement of erection until its completion. On many days erection was suspended for grouting, the tunnel being too small to drive and grout at one time; there were also delays from pockets of groundwater in the roof and from hardpan and boulders. When everything was favorable the usual progress was three rings in each 8-hr. shift, or 20 ft. 3 in. of completed tunnel in 24 hr.

The drawing Fig. 1 herewith shows the details of the shield, erector, platform and H-bars. The erector, operated by two turning jacks, had a range in either direction of 375° and a longitudinal motion forward and back of 5 in. for inserting the projections of the lining blocks in the recesses. The grip used may be seen in Fig. 4.

Setting Blocks Accurately—It is of great importance in concrete-block tunnels that the block be set by the erector without recourse to crowbars or other means of getting it into position, and also that the rings in the neighborhood of the shield jacks should be firmly clamped while the shield is being shoved. How this can be done is shown in Fig. 2, together with the other changes from previous practice. Modification of the erector grip and H-bar holders, based on the Flushing experience, enables the blocks to be set in their exact position by the erector without otherwise being touched, and to be clamped by the bars for five rings from the face. Moreover, the erector is carried on the H-bar platform instead of on the shield, leaving the

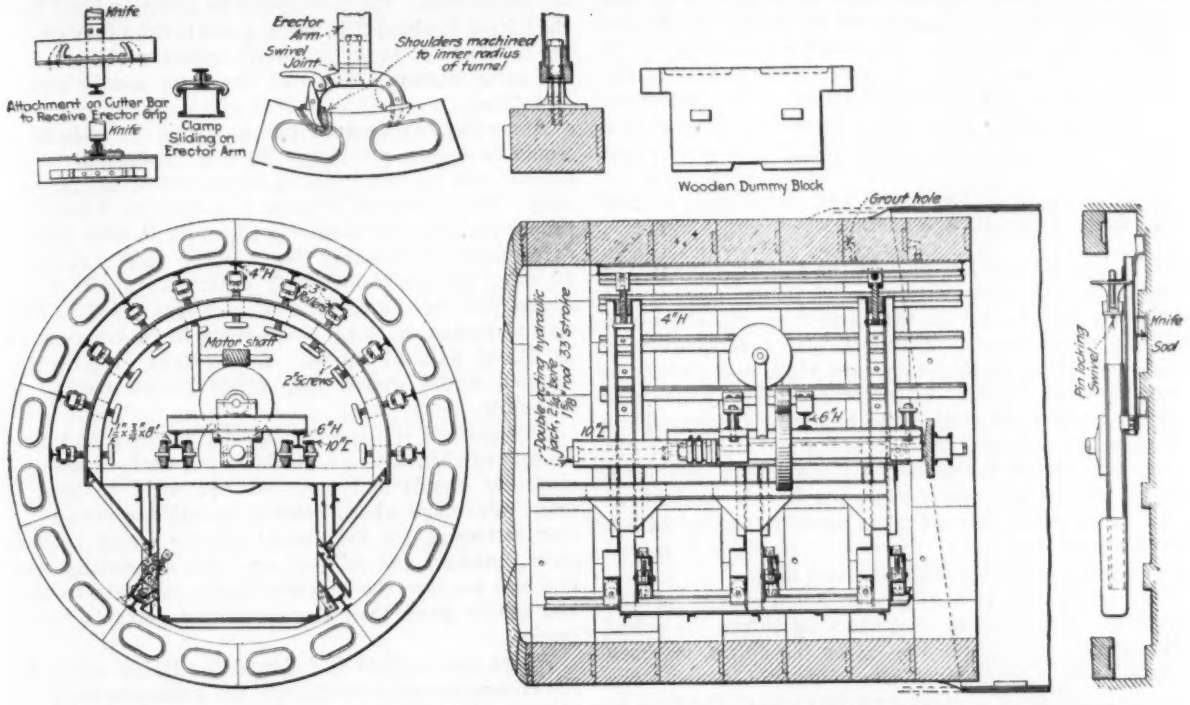


FIG. 2. NEW TRAVELING PLATFORM AND OTHER IMPROVED DETAILS FOR CONCRETE-BLOCK TUNNELING

latter free from obstruction and its only function the holding of the ground. The platform is carried on wheels resting on rails which are pulled forward before the platform is moved by aid of jack screws that lift each side of the platform alternately off the rails. Moving the platform forward is done by the erector on the platform, which has a longitudinal motion greater than the width of a ring.

The grip is attached to the erector arm with a swivel joint, capable of being both tightened and locked, and is fitted with two shoulders, the faces of which are machined to the inner radius of the tunnel. One of the jaws that enter the grip holes is rigid, the other swinging on a pin and being locked in position by a cam. Whenever the inner surface of the block is not in perfect contact with the shoulders of the grip the erector arm can be swung to an upright position and the cam loosened sufficiently to permit the block to slide down the jaws to a perfect contact with the shoulders, when the cam is again locked with the concrete block held exactly to fit into the arc of the ring. The swivel joint allows the block to adjust itself in the vertical plane of the ring when it is moved backward, bringing the projections of the block against the back of the recesses of the previous ring. This is assisted by half the top of the H-bar, supporting the adjoining block, affording a surface upon which the block may rest while it is being shoved into place. This H-bar also should be used to support spacers to maintain the correct size of the longitudinal joint and support the arch before the joint is grouted. The width of the circumferential joints is fixed by the excess length of the projections over the depth of the recesses.

As already stated the movable H-bars at Flushing

FIG. 3. TRAVELING PLATFORM, FRONT VIEW AFTER REMOVAL OF SHIELD AT TERMINAL SHAFT

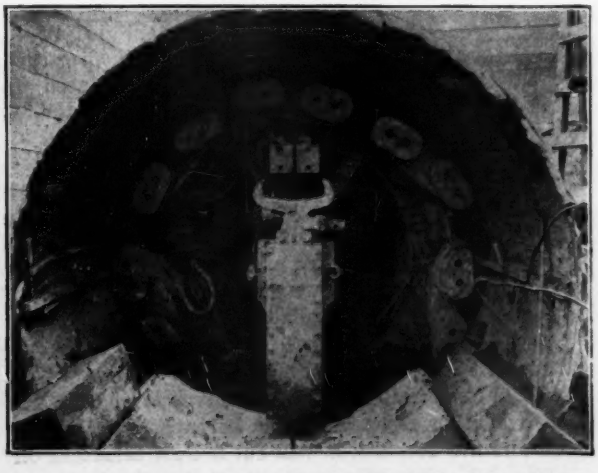


FIG. 4. FLUSHING SHIELD STARTING OUT FROM SHAFT; ERECTOR MOUNTED ON REAR OF SHIELD

had not sufficient outward play to be always in contact with the interior surface of the rings. In the new design this difficulty is overcome by inserting the H-bars in castings attached to the ends of the jack screws and bearing on rollers in the castings. The screws are of a length to give the H-bars sufficient play so that they can be clamped in contact with five or more rings, thus supporting them during a shove, preserving the cylindrical form of the tunnel and maintaining adjoining blocks flush with one another.

Block and Form Design—At the Flushing tunnel the key-block was made with parallel joints, so that the closure could be set in the same way the closure is set in a cast-iron-lined tunnel. This required four different kinds of blocks in each ring, and there was usually some difficulty in entering the key, which was generally done by setting the adjoining blocks a little high on the side toward the opening and then when the ring was closed lowering the three blocks into place together. In the new design the key is a standard block with radial joints that is set after the shield has been shoved and before the erector platform is moved to its position for erecting the next ring.

To accomplish this a wooden dummy block of the design shown is set to close the ring before the shield is shoved. This is removed after the shield has been shoved but before the platform is moved forward. The concrete key-block is swung up forward of the ring in the space for the next ring and moved backward into place by longitudinal motion of the erector. The ring being now closed and made self-supporting by packing or wedging the key block, the H-bars are unclamped, the platform is moved forward for the next ring, the H-bars are again clamped against the rings and the jack screws at the bottom of the platform clamped against the rails, and the new ring is erected with its dummy-block closure.

This key-block with radial joints gives a better ring than the old form of key and obviates the difficulty of using four different kinds of blocks in the same ring. It also greatly simplifies the molding of the blocks, which are now uniform and can be molded singly in separate forms. Block forms with cast-iron bottoms were used at Flushing, but the bottoms of the new forms can be made of hard wood, reinforced with three flat bars to take the bearings of the steel sides and to hold the fastenings of the side and end plates.

Tunneling Without Shield—An important feature of the new apparatus is that when tunneling in firm clay the shield may be omitted and the erector used to excavate the tunnel and erect each ring immediately after the space for it is excavated. This is done, as shown on the drawings, by attaching a bar to the erector that carries knives which cut sods from the face, similar to a well known tunnel machine. The erector grips hold the bar firmly through an attachment at the outer end, the inner end having a sliding connection with the erector arm permitting the bar and knives to move outward radially while the arm is being rotated. The drawing shows three knives 30 in. apart, cutting sods 6 in. wide and 3 in. thick. It follows that with a uniform radial movement outwards of 6 in. for each revolution of the arms the knives will describe a helix and five revolutions will cut a 3-in. thickness off the entire face. The sods would be taken by hand from the knives in about 2-ft. lengths and thrown into a muck car by two men, as the two inner knives would cut about the same amount of sods as the outer one is capable of cutting.

Assuming the tunnel rings to be 24 in. wide there would be 8 cuts per ring. At five revolutions of the erector arm per cut it would require 40 revolutions per ring. Thus it would require less than an hour, with proper facilities for removing the muck in that time, to drive sufficient heading for another ring. Allowing 30 min. for erection, which experience shows to be ample, driving and erection of each ring could be done on an average in 1½ hr. or 16 rings in 24 hr., equal to 32 ft. of finished tunnel. An average of half that amount would exceed any other known method of tunneling.

This method of using the erector to drive and erect tunnels in clay, where a shield is not used, is new but obviously simple and practical. It could be used to great advantage where brick or monolithic concrete is now employed, for the tunnel driving would be done safer, quicker, and without cost for supporting roof, and also because the concrete blocks cost less to mold and set in place than the monolithic concrete or the brick.

Where this method is followed the lining which fills the excavation gives practically the same support to the ground that is given by a shield and no subsequent settlement need be feared. If some timbering is necessary for the short length of roof left unsupported while the cut for the new ring is being made, that can easily be done with the help of the movable H-bars. The tunnel can also be driven in exact line and grade, as each ring as set can be placed in its true position.

Filling the Clearance Void—It has been found impracticable to shove a shield exactly right for line and grade, so that a small space should be allowed for outside the lining within the tail of the shield to admit of adjusting the new ring on blocking in its exact position. It is also essential to fill the space around the lining that is left by the shield, so that the blocks may be held in place as set. This packing also sustains the ground from settling. Gravel packing was used for these purposes with great success at the Flushing tunnel and also in connection with recent East River tunnels.

Summary—Experience indicates that the new apparatus will fully avoid the difficulties that have heretofore been encountered in driving concrete-block tunnels, with or without shields. One of the advantages of cast-iron-lined tunnels is the freedom with which cast-iron plates may be handled in contrast with the concrete blocks, which, while very strong, are liable to suffer abrasion and spalling during erection. The new methods avoid this form of injury to the blocks, and a concrete-block tunnel built as described, packed with gravel and thoroughly grouted, may now be adopted with confidence instead of one with the costly cast-iron lining. It is true that many engineers object to concrete blocks because of former difficulties of erection and also for lack of sufficient precedents for their use. However, such objections as the foregoing are now things of the past.

Acceptance of Pavement Based on Core-Drill Tests

Drilled Specimen Final Test in North Carolina—Drill Truck Carries Hole-Plugging Outfit—Tests Form Permanent Record

CORE-DRILL tests of the completed slab must be satisfactory before final estimates are paid on paved road construction in North Carolina. Ordinarily in the past cores have been drilled primarily to determine the constitution and structure of pavements and not as a means of determining the acceptability of completed work. Their use for the newer purpose is an additional use to which they are being put with good effect in preventing careless construction and without any detriment to their value for research purposes. Records of the tests are preserved by means of the form shown in Fig. 1.

Form T 41

NORTH CAROLINA
STATE HIGHWAY COMMISSION
RALEIGH, N. C.

DIVISION OF TESTS AND INVESTIGATION

DRILLED SPECIMEN REPORT COUNTY

Lab. No. ____: Core No. ____: Identification ____: Date forwarded ____ 19__
District No. ____: Project No. ____ Date Laid ____ 19__: Date Drilled ____ 19__
From ____ To ____: Date Received ____ 19__
Type of Pavement: ____: Date Tested ____ 19__
Total number cores drilled from project ____

Why drilled? ____

Drilled by ____: Time ____ (min.)
Total number drilled today ____: Time ____ (hrs.)

THICKNESS	Designed	Actual CORE	Actual HOLE
	Base ____ (in)	Base ____ (in)	____ (in)
	Top ____ (in)	Top ____ (in)	____ (in)
	Ave for proj.	B T	B T

MATERIALS USED IN CONSTRUCTION

Portland Cement Concrete	Bituminous Mixture
Cement	Cement
Fine Aggregate	Fine Aggregate
Coarse Aggregate	Coarse Aggregate

POSITION SKETCH

W

Station

Indicate location at place from where the core was drilled.

TEST DATA

Contractor:

Resident Engineer:

Inspector:

Remarks:

Signed.....

FIG. 1. FORM FOR DRILLED SPECIMEN REPORT
Original sheet is 8½ x 11 in. with a left-hand stub to be punched for binding the record into a filing cover.

Samples are taken by means of the outfit illustrated by Fig. 2. This consists of a 3-ton motor truck, with a covered body on the tail of which is mounted a Calyx core drill with a 7½-in. bit. The drill is belt-driven by a separate 8-hp., two-cylinder gasoline engine. Inside the truck there are also a 130-gal. water tank, a hand force-pump for filling the tank, bins for sand, stone and cement for molding repair plugs, plug molds, accessories and repair parts.

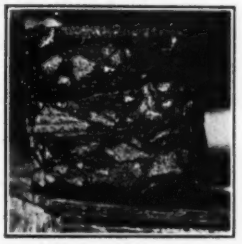


FIG. 3. CORE DRILL SPECIMEN

In operation, the truck is spotted at the place where the sample is wanted, and the drill, operating at 200 r.p.m., cuts a 6¼-in. core from an 8-in. pavement in from 20 to 30 minutes. About 3 lb. of shot are required for one boring, and, under average conditions, about 3 gal. of water. When drilled, the core is marked and shipped to the testing laboratory at Raleigh, where it is measured, tested for strength and analyzed for physical composition. The results are recorded on the form Fig. 1. Fig. 3 shows a core from a bituminous top on a concrete base.

The drill holes in the pavement are filled with plugs molded in the field from materials carried by the truck.

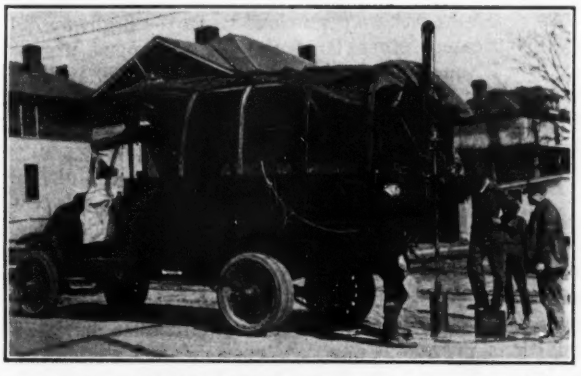


FIG. 2. CORE-DRILLING OUTFIT IN OPERATION

The plugs are molded slightly smaller than the drill hole and are sealed into place by a quick-setting cement grout. The drilling outfit is operated by the Division of Tests and Investigations of the North Carolina State Highway Commission.

Money Saved by Painting Bridges

The life of many steel highway bridges is materially shortened because of infrequent and improper painting, says the U. S. Bureau of Public Roads. Each year a considerable amount of money is expended for the replacement of rusted bridge members which could have been avoided if they had been kept painted; and more serious than the waste of money is the positive danger to the public which results from such carelessness due to the weakening of some hidden part which may cause the collapse of the whole bridge. Officials of the bureau urge that all steel bridges be inspected at least once each year and repainted at the first sign of rusting. Normally repainting is required at periods of from two to five years depending on the climate. A suitable paint should be used and if there is uncertainty as to the suitability of any paint, information should be requested from the state highway department. It is a mistake to repaint without properly cleaning the metal of all dirt, rust, loose paint and blisters. Usually the places hardest to reach are the ones that should receive the most attention.

What One State Highway Bridge Department Has To Do

Survey of Work Under Georgia State Highway Department Indicates Diversity of Problems to Be Solved

By Searcy B. Slack

Bridge Engineer, State Highway Department of Georgia, Atlanta, Ga.

Under the constitution of the state of Georgia the authority to construct roads and bridges is vested in the boards of county commissioners (or ordinary where there are no county commissioners), of the 160 counties. With 160 separate agencies and no definite plan it can be readily understood why comparatively little progress had been made in systematic bridge construction until the inception of the state highway department in 1917. A few of the counties had learned the value of engineering work on the more important structures but most of them were building either without skilled supervision or simply with the advice of the bridge companies.

As a result of these conditions when the highway department came into existence one of the most urgent needs of the state-road system was the immediate construction or reconstruction of a large number of bridges. Many sections of the state were served by ferries or low-water bridges and traffic was frequently interrupted by high water. The policy of the highway board has been to favor the counties desiring to cooperate in the construction of "permanent" bridges.

The legislature passed an act creating the highway commission in August, 1917, but the commission did not begin to function until late in the fall. Plans for several large bridges were prepared in 1918 but war conditions prevented any construction until the spring of 1919. Since then there have been completed 217 concrete bridges, with a total length of 31,619 ft.; 12 steel bridges, totaling 4,142 ft.; and 26 wooden bridges having a length of 6,323 ft. A total of 255 bridges having a combined length of 42,084 ft. were completed from March, 1919, to January, 1922. These bridges are all more than 20 ft. long. Figures are not available for drainage structures less than 20 ft. in length.

Practically all bridges constructed have a width of 18 ft. between curb faces, or a little more than 19 ft. between railings. A few bridges having widths of 16 ft. have been constructed in the mountainous sections of the state and a few of greater width where the locations were close to towns.

Bridges on State Roads—In August, 1921, the state legislature passed an act directing the state highway department to take over for maintenance on Jan. 1, 1922, the entire state-road system comprising about 5,600 miles. A census of the bridges to be taken over under this act has just been completed and shows 1,101 wooden bridges, with a combined length of 64,674 ft.; 254 steel bridges totaling 19,493 ft.; and 38 concrete bridges having a total length of 3,600 ft. None of the bridges constructed by the state highway department is included in this table. Practically all of these 1,393 bridges should be rebuilt in the near future to meet the requirements of modern motor loadings. Many of the steel bridges can be taken down and utilized on the county-road systems.

The total number of bridges on the present state-road system, both new and old, is 1,648 and the total length is 129,851 ft. No interstate bridges or bridges on the county-road systems are included above. The county systems comprise about 75,000 miles of road but no figures are available for structures on these roads. These figures show that during the last three years Georgia has constructed about one-third of the existing length of bridge structures on the state-road system. Seventy-five per cent of the new bridges are of reinforced concrete.

A study of the 5,600-mile state-road system shows that only about 14,000 lin.ft. of entirely new construction, in addition to the bridges already built by the state and counties, will be necessary. When all bridges on the state roads are completed the total length will be approximately 144,000 ft.

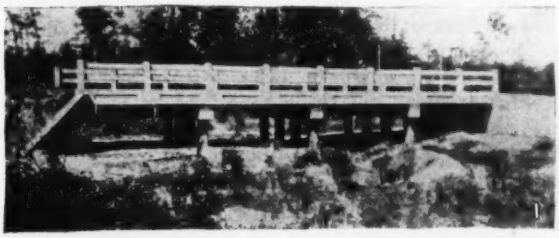
Very little progress has been made in the construction of interstate bridges. The Georgia-Alabama state line below West Point, Ga., is the low-water line on the west bank of the Chattahoochee River, all of the river and islands being in Georgia. Until very recently Alabama was prohibited by law from building beyond the state line, so joint bridge projects were impractical. The last session of the Alabama legislature corrected this trouble so that an equitable division of the cost can now be made.

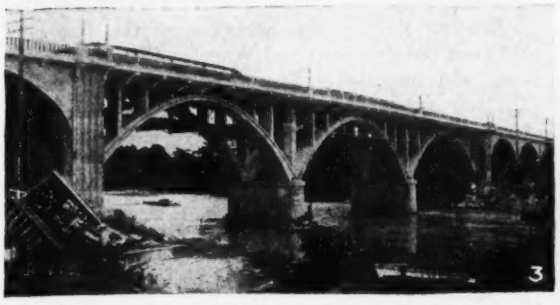
Development during the next few years will probably justify the construction of three bridges between Georgia and Alabama, three between Georgia and Florida and six between Georgia and South Carolina. The total length of these interstate bridges will be about 25,000 ft.

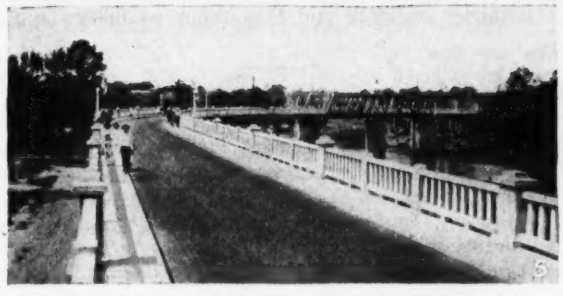
Types of Bridges—Foundation conditions in Georgia vary so widely that no particular type is adaptable to all sections. The majority of the concrete bridges, however, consist of deck-girder spans supported by two-column bents or precast concrete-pile bents. On the two-column bents the footings are separate, each being about 6 ft. square. In wet work this makes a small cofferdam and reduces the size of the pumping equipment necessary. This type of bent has proved very economical and satisfactory.

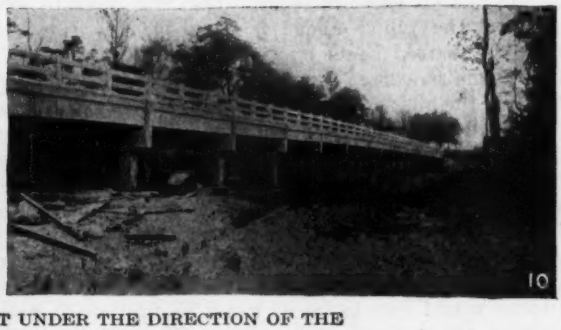
Precast concrete-pile bents have been used principally in the southern part of the state where foundations are generally deeper. Precast piles are easily handled and under certain driving conditions are satisfactory but no scheme has yet been devised for predetermining the necessary lengths before driving. Frequently, using both jets and hammer in driving, piles in the same bent about 18 ft. apart show penetrations differing as much as 5 ft. This necessitates building up or cutting off the piles, and precast piles soon lose their economy if many cutoffs are necessary. This difficulty is not met, of course, where the soil is at all uniform, but uniform soil is comparatively rare in the stream valleys of this section.

Concrete abutments have been built for about 75 per cent of the new bridges and for the other 25 per cent end bents with fills extending between the legs, sheeting behind pile bents and various other schemes have been used. The abutments are nearly all of reinforced concrete and are built 26 ft. wide from shoulder to shoulder. A few of the earlier abutments were only 22 ft. 6 in. between shoulders but the difficulty of maintaining a roadway to a narrow abutment was soon apparent.









TYPICAL HIGHWAY BRIDGES BUILT UNDER THE DIRECTION OF THE GEORGIA STATE HIGHWAY DEPARTMENT

1—Typical precast concrete-pile bent bridge.
2—Toccoa River truss bridge; 150-ft. span.
3—River spans of Flint River bridge, Albany, Ga.
4—Crossing of Oconee River at Mt. Vernon, Ga.
5—Approach to swing-bridge over Ocmulgee River.
6—Twelve 30-ft. arches over gum swamp.
7—Seven 54-ft. deck girders over Oconee River.
8—Cantilever of 50-ft. span over Alcovy River.
9—Vertical-lift span over Flint River.
10—Concrete trestle on two-column bents.

Abutments up to 18 ft. high are of the cantilever design: for heights of 18 ft. and more the counterfort design is used.

Precast concrete railings of several different types have been used and are satisfactory provided proper attention is given to the expansion joints. When vertical spindles are used it has been found best to have the bottom rail above and separate from the curb or rail beam. If this is not done the top rail and bottom rail will have different rates of expansion and the spindles near the expansion joints will generally be cracked. If half-spindles are used next to posts they should either be cast with the post or separated from the post by a small open space. If expansion material is used to separate the half-spindle and post the half-spindle will nearly always crack.

A brief description of a few of the more noteworthy projects may be of interest.

Project 81—The bridge over the Flint River at Albany, Ga., has a length of 773 ft., and consists of 8 filled-spandrel approach arches with spans of 53 ft. and 3 open-spandrel ribbed arches with spans of 93 ft. over the river. It has a 32-ft. roadway and two 6-ft. sidewalks. Steel centering was used for the 93-ft. arches, two three-hinged steel arches being used for each rib. Six steel arches were used to center the upstream line of ribs from abutment pier to abutment pier. After the ribs had set, the centering was loosened and shifted downstream for the down-stream line of ribs. After these ribs had set, the centering was again loosened and shifted between the ribs and used to shore up the floorbeams and deck slabs. Wood truss centering was used very effectively for the 53-ft. approach arches. The bridge was opened to traffic July 4, 1921.

Project 195—In the crossing over the Altamaha River at Darien, Ga., there are six bridges consisting of 3,900 lin.ft. of wood trestle, one 45-ft. steel-girder span and two 245-ft. steel swing-spans, making a total length of 4,430 ft. The stream crossing was originally built in 1911 by the Georgia Coast and Piedmont R.R. which was sold and dismantled in 1919. Interested citizens and Glynn and McIntosh Counties bought the bridges and fills and turned them over to the state highway department to be reconstructed for use as a highway. The old railroad fills were widened and surfaced with shell. The old railroad trestle, consisting of pile bents, was in such bad condition that complete reconstruction was necessary. This was done by cutting off the piling about 2 ft. above low tide and building framed bents on the piles. There is a 5-ft. tide in the streams. By cutting the piles off just above low tide the piles and pile cap, although they are exposed daily, are constantly wet and there is little chance for decay. The posts between the pile caps and the bent caps will decay in time but these can be replaced easily without interrupting traffic. The original plans for the trestle contemplated the use of creosoted materials for all parts except the flooring but when the contract was let, in September, 1920, it was found that creosoted timber would cost twice as much as first-grade heart cypress and under these conditions the cypress is the more economical. The bridges have an 18-ft. roadway except through the steel swing-spans which were built for a single track and have a clearance of only 15 feet.

An interesting feature of this stream crossing is the small discharge area required for the 14,600-sq. mile drainage area of the Altamaha River. The area below high water is approximately 35,000 sq.ft. Several crossings of this river farther inland have more than double this area below high water. For a considerable distance above the bridge site there are wide marshes and swamps and these serve as reservoirs and effectively regulate the discharge. Extreme high water is about 1 ft. above high tide, but during time of freshet there is almost no tidal variation, the discharge being maintained constantly toward the sea. Work began in December, 1920, and the bridge was opened to traffic in June, 1921.

Project No. 8—The bridge over the Oconee River between Montgomery and Wheeler Counties is 2,378 ft. long and consists of 54 concrete deck-girder spans 35 ft. long, supported by two-column bents; three 100-ft. through riveted trusses with concrete floors and one 180-ft. steel swing-span. It has an 18-ft. roadway and is paved with wood block. This is the longest concrete and steel structure in Georgia.

Practically all of the new bridge work in Georgia has been done by co-operation between the counties, state highway department and the U. S. Bureau of Public Roads under the direction of W. R. Neel, state highway engineer and the author as bridge engineer.

Colors for Traffic Signals

Standardization of colors for traffic signals, in the interest of public safety, was recommended by the signal section of the American Railway Association at a recent conference attended by the Illuminating Enginering Society and International Traffic Officers Association and held under the auspices of the American Engineering Standards Committee. The recommendations are as follows: (1) Red for stop everywhere unless qualified by a more favorable indication. That is, at highway crossings with railroads if train is approaching, in fixed signals and in the hands of traffic officers, at street intersections, at the ends of streets and possibly to indicate street excavations; (2) yellow for tail lights of automobiles, possibly street excavations, for calling policemen and for any purpose where caution is required; also possibly at busy street intersections to indicate that the traffic lights will be changed from red to green or green to red; (3) green for fire-escapes, for "proceed" at street intersections and for other purposes to indicate the way is clear.

In presenting these recommendations A. H. Rudd, chief signal engineer of the Pennsylvania R. R. system stated that the railroads are particularly interested in eliminating the use of the red light for various purposes. They have used yellow for caution and green for safety for several years. The public generally understands that red means danger, but this color has been so misused as to weaken its significance. For instance, the use of a red light for a fire exit in a theater is absolutely wrong. This signal means that the exit should be used in a hurry in case of emergency, and the light should indicate "proceed" instead of "stop" or "danger." It is stated that many crossing gates are broken owing to automobile drivers mistaking the red light on the gate for the tail light of an automobile and turning to the left to pass it. This was the primary reason for suggesting that tail lights on automobiles be changed to yellow.

Drain Tile Tests Show Concrete Affected by Alkali

Third Progress Report Carries Observations on Test Tile Placed in 1913 in Alkali Soils Through 1920

OBSERVATIONS on the behavior of concrete drain tile and concrete blocks in alkali soil are reported upon in the third progress report of a group of engineers under the general direction of the United States Bureau of Standards in Technologic Paper No. 214 of the Bureau just issued. This paper is entitled "Durability of Cement Drain Tile and Concrete in Alkali Soils: Third Progress Report (1919-1920)" is by G. M. Williams, who was at that time associate engineer of the Bureau of Standards, and was written in cooperation with consulting engineers and representatives of government departments as well as a representative of the Engineering Institute of Canada, the Portland Cement Association and the American Concrete Pipe Association. The tile under study were placed in 1913 in eight alkali bearing districts in the West. According to the conclusions of the latest report the best quality of concrete will disintegrate when exposed to severe alkali attacks and installations of concrete in soils containing more than 0.1 per cent of salts of the sulphate type should be preceded by an examination of surrounding conditions.

Drain tile of 16 varieties were installed in working drains in western states. Five additional types have since been provided to replace tile removed for tests. At the same time a large number of concrete blocks were molded and placed in alkali waters. Variations in brand of cement and proportions of concrete as well as types of manufacture were made. Early inspections showed that both the tile and the blocks were seriously affected by the alkali attacks. The 1919 field investigation showed that in general the condition of the tile was quite similar to that found in 1916 and that average strength results as well as appearance of the tile with respect to salts in the walls had not been greatly changed by three additional years' exposure.

A summary of the results of the inspection and tests is given in the report. It is stated that durability of concrete drain tile for any given concentration appears to vary with the richness of the mix and consistency. Hand-tamped tile are less resistant to action than machine-made tile made of the same mortars. Tile made with sufficient mixing water to result in such a consistency that they must be retained in the molds for several hours have proved more durable than richer mix tile of the machine-made type of such a dry consistency that the jacket may be stripped immediately. As a class it may be said that wet mix tile have been much less affected by alkali action than dry mix tile.

Inspection of drain tile and concrete structures in other localities where the alkali salts are of the chloride or carbonate types seem to justify the conclusion that these waters are not so severe as waters of the sulphate type which are found in all of the drains in the alkali districts. In waters of the sulphate type severity of action appears to vary with the concentration of soluble salts. For the concrete blocks somewhat the same observations are made and the additional one that with the same aggregates lean mixtures are more seriously and rapidly affected than rich mixtures. Durability appears to be dependent upon impermeability, which is mainly dependent upon richness of mix and gradation of aggregates.

Conclusions—The following conclusions end the paper:

1. Results to date indicate that materials of good quality and proper workmanship are of great importance in the production of concrete which is to be exposed to alkali soils and waters.

2. Action noted on surfaces of concrete blocks of best quality after one year exposure in sulphate waters has in most cases been progressive, depending upon conditions of exposure.

3. Extent and rapidity of disintegration in sulphate waters depends upon concentration of salts in waters to which the concrete is exposed.

4. In blocks containing reinforcing rods disintegration appears to be aided and accelerated in some cases by corrosion of embedded steel and consequent cracking of the concrete, as has been observed in some reinforced-concrete structures exposed to sea water.

5. Structures placed in alkaline soils or exposed to alkaline seepage waters should be given all possible protection by drainage.

6. Seepage waters and alkaline soil conditions may be encountered which will disintegrate concrete of the best quality, and proper consideration should be given to soil and water conditions and protection by drainage and other means when it is proposed to expose concrete structures to conditions similar to those in which these test blocks have been placed.

7. Alkali salts are not uniformly distributed throughout the soil or large bodies of seepage waters, and it will be difficult to determine in advance the concentrations to which a structure may later be exposed. A systematic scheme for sampling soils will furnish information as to the quantities and types of salts available for solution, while analyses of seepage waters will indicate the concentrations present at the time of sampling. Disintegration is brought about only by those salts which are in solution as indicated by analyses of water samples, while the soil analyses merely represent reserve supplies which may bring about changes in the existing solutions with changing conditions of rainfall, flooding, etc. The problem of drawing conclusions as to the most severe conditions which may occur becomes more difficult when the source of supply of the salt is through underground seepage from some distant point.

8. For the same concentration of soluble salts, and for the same aggregates, resistance of mass concrete to alkali action appears to vary with cement content or richness of mix, within the limits employed in these tests.

Carrying Out the Chicago City Plan

Street widenings are an important part of the city improvement work now being undertaken at Chicago by the Board of Local Improvements in accordance with the "Chicago Plan," according to the latest annual report of the Chicago Plan Commission. Three important streets on the west side which are to be widened and opened up to form continuous north and south thoroughfares for the 26-mile length of the city are Ashland Ave., Robey St. and Western Ave. Several streets in the business district just west of the river are to be widened to facilitate the development of a warehouse and commercial district. Much of this work is in the preliminary legal stages but physical progress has been made in widening some streets adjacent to the congested loop district and in extending Ogden Ave. as a diagonal thoroughfare northeast from Union Park on the west wide to Lincoln Park on the lake front.

Eliminating a Tunnel Without Interrupting Traffic

Bessemer & Lake Erie R.R. Improves Critical Point by Deep Open Cut—Bridge Built Over First Lift of Cut—No Work Trains on Main Tracks

CONTINUAL TROUBLES with the maintenance of a tunnel in unstable ground have led the Bessemer & Lake Erie R. R. to eliminate this tunnel by converting it into an open cut. Difficulties were encountered due to the necessity of executing the work without interrupting the heavy traffic on the railway and on a highway crossing the line of the tunnel.

Tunnel Conditions—The Culmerville tunnel about 20 miles south of Butler, Pa., was 394 ft. long, all on tangent, and had a width of 26 ft. at the springing line. It was built in 1897 and originally carried a double-track line, but it gave very limited clearance for present equipment and after its reinforcement by a timber

FIG. 1. TUNNEL ARCH BRACED TO PREVENT FAILURE
Double track gantletted for single-track operation

lining for the arch in 1921 the tracks were gantletted for single-track operation. This tunnel with its roof bracing and gantletted tracks is shown in Fig. 1.

In the original design a horseshoe section was adopted, with side-walls of cut stone and a semicircular six-ring brick arch. Cut stone was used also for the portals. Since the lower portion was in sound shale rock no invert was necessary. But overlying the rock was a mixture of clay, loam and soft shale which was liable to slip when wet. Being located in a saddle in the hills the tunnel has always been wet with seepage water.

In this bad ground considerable trouble was encountered when building the tunnel and it was found necessary to place a timber lining to hold the excavation while the permanent lining was being built. Trouble was experienced also after the tunnel was in service, and in 1909 a settlement of the arch necessitated the placing of heavy timber bracing. In 1909 also a timber-lined drainage tunnel 5 x 5 ft. was driven parallel with the railway tunnel on the west side and level with the crown of the latter. This relieved the situation somewhat in respect to water and was followed by renewal of part of the brick lining.

After this relining and the repointing of the brick the material behind the arch was grouted by means of 3-in. pipes about 25 to 50 ft. apart, put through the brick arch at the crown. Cement grout was forced through the pipes by a grouting gun, this being continued at each pipe until no more grout could be taken up. About 2,000 barrels of cement and 75,000 brick were used in the above repairs, which proved effective for some time.

In the winter of 1920-1921 bricks again began to spall out and the tunnel showed signs of slight distortion. As a precautionary measure a heavy timber lining was put inside of the brick arch and the tracks were gantletted so as to give only a single running track through the tunnel (Fig. 1). Studies were then made for either permanently relining and enlarging the tunnel or making an open cut. The latter plan was adopted and a contract for the work was awarded on Sept 3, 1921. Fig. 2 is a profile of the tunnel and cut. Fig. 3 is a cross section at the highway which has to be carried over the cut.

At the time of original construction it is probable that the tunnel was cheaper than an open cut and that the conditions above the tunnel involving extensive highway changes and litigation with property owners were factors in deciding on the tunnel. From Fig. 2 it will be seen that five improved highways converge into one highway crossing over this tunnel. The traffic is very heavy and on July 4, 1921, this joint section of highway carried 3,887 automobiles, 18 horse vehicles and 87 pedestrians. No detour was possible during construction. Further, the highway had to cross the cut by a bridge practically in its original position near the middle of the tunnel.

Bridge over Tunnel Cut—Among the first considerations therefore was the provision for highway traffic while building the bridge. A temporary road was graded across the south end of the tunnel, as shown, and this road was used from the beginning of work in September, 1921, until traffic was turned over the new bridge on April 1, 1922. No change was made in the location of the main track and the work had to be carried out so as not to interfere with railway traffic. As the tunnel is on the main line, with very heavy traffic and with no possible detour in case of blockade of tracks, the contractor was not allowed to use the tracks or to interfere with them in any way.

The first step was to make the excavation in the cut down to rock from the north portal to the temporary road over the south end of the tunnel. This work was so far completed in December that the abutments for the bridge could be built and these were completed about the end of January. The steel was erected during February and very little additional excavation was done in the cut while the bridge was being built. Fig. 4 shows the work on April 1, 1922, as resumed after the completion of the bridge. The steam shovel is at the right of the tunnel roof and some of the ribs of the old exterior timbering can be seen under and beyond the head of the boom. The original main line cut and top of north portal are in the background.

A reinforced-concrete floor is to be laid on the bridge but winter weather prevented this work being done immediately after completion of the steelwork. Only the

floor forms and the reinforcing bars were placed at that time, a temporary floor of 7 x 9-in. bridge ties being then laid so that the bridge could be opened to traffic, thus releasing the temporary road and allowing the work of excavation in the cut to be continued. It was required that the bridge should be opened for traffic before the temporary road was removed and as there was no way of making a detour for the road it was necessary to get the highway bridge in service as early as possible. For this reason the temporary floor was placed. It is so laid that one half can be taken up and the concrete floor put in while the other half is in use. After the half floor of concrete is sufficiently cured traffic will be turned over it and the other half built. The concrete floor construction is shown in Fig. 3.

The concrete abutments are of the gravity type and of a general U-shape, curved wings being used to provide easy approaches. The bridge is of sufficient length to span four tracks, thus providing for the widening of the cut for additional tracks when necessary (Fig. 3). Concrete was placed during the winter but owing to the open season it was sufficient to provide the ordinary precautions of heating all the materials and keeping a

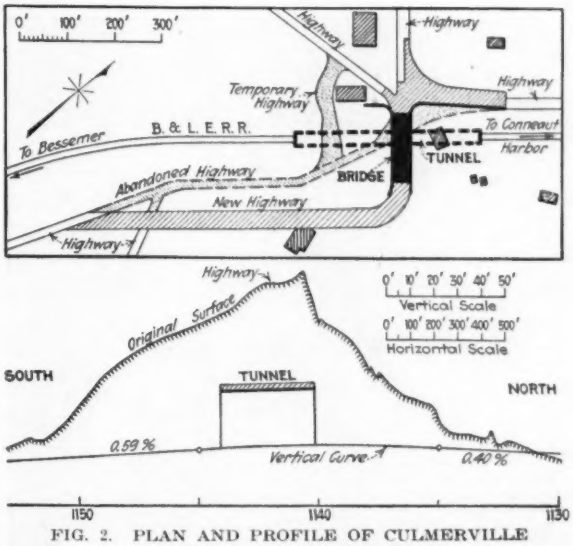


FIG. 2. PLAN AND PROFILE OF CULMERVILLE TUNNEL IMPROVEMENT

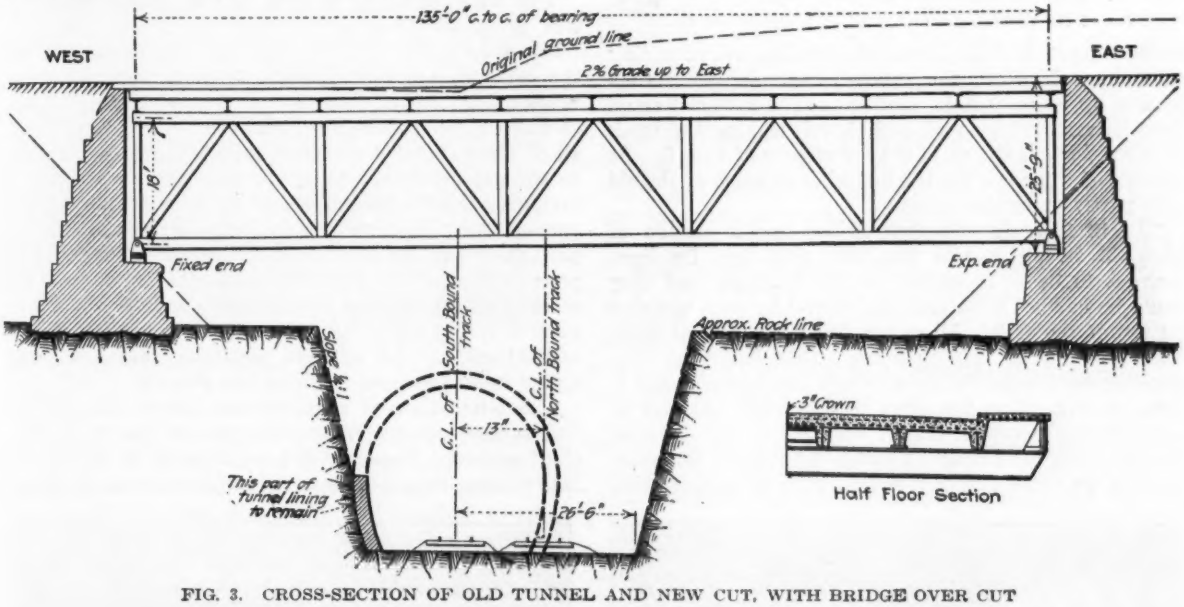


FIG. 3. CROSS-SECTION OF OLD TUNNEL AND NEW CUT, WITH BRIDGE OVER CUT

canvas cover over the concrete, with fires around abutments and lines of steam pipe under the covering. The foundations are in the shale rock found in the lower part of the excavation, the berm between rock slope and earth slope being about at the top of the foundation course.

Heavy construction was required for this bridge in order to provide for future electric cars in addition to the 16-ton trucks now specified for highway traffic loading. Floor work was done during March and traffic was turned over the bridge on April 1.

Opening the Tunnel—During March good progress was made south of the tunnel with traction shovels and motor trucks in excavating material above the rock line on the east slope of the cut where widening was required. Beginning in April the work in the cut over the tunnel was pushed to the limit of the plant that could be handled economically in the limited area. Also beginning at the north portal of the tunnel where the top excavation had been completed several months previous, the work of stripping the brick arch of the tunnel was in progress. This work below the rock line was done by hand, the material being loaded in skips and handled to narrow-gage dump cars on a track in the cut by stiff-leg derricks erected on the rock berm.

Stripping of the arch was of particular interest in revealing the results obtained by the grouting done in 1910. Except in a few places just over the crown, the entire tunnel excavation behind the lining was found to be a solid mass of concrete, in which was imbedded the original timbering and the stone packing between the timber bents. In Fig. 6 the upper view shows the crown of the old timbering, with the haunches embedded in a mass of grout. In some cases the ribs were completely encased and in all cases the sides were well grouted.

After the removal of the original rock and shale to expose this concrete casing a row of holes was drilled

FIG. 4. BRIDGE ERECTED BEFORE OPENING TUNNEL
Ribs of old timbering under head of steam-shovel boom.

around the arch through the concrete but not extending into the brickwork, the grouted concrete being then broken up by very light shooting. The material could then be removed by pick and shovel, leaving the brick arch exposed, as shown in the lower view of Fig. 6. At the left of this view are the haunches of some of the old ribs partly embedded in grout

The brick arch was then drilled and a section of about 3 ft. all around the arch was shot by light charges in order to loosen up the brick so that they could be handled with pick and shovel by men working on top of the arch. All except the inner ring of brick was removed in this manner. This last ring was knocked down onto the track, where the material was at once thrown off to the sides to be picked up later a opportunity between trains afforded. The interior timber lining was removed either later or at the same time as the brick was torn down. It is to be noted that the timber ribs inside the tunnel served as a support, so that a considerable length of one ring of brick has been left standing during an entire day when a section of the brick arch was being taken down.

Removal of the brick arch was done on Sundays when the railway traffic was light, but the work could have been carried on at any time. Fig. 5 shows part of the arch removed, exposing the temporary timber lining inside the tunnel. The several kinds of lining are plainly shown, including the inside timber ribs, the brick arch, the outside timber rings and the grouting. Portal bracing is shown in the view at the left.

Disposal of Spoil—In taking out the top lift of the excavation the contractor used traction shovels and motor trucks and utilized the highways for carrying the material to various dumping places. Sand and coarse aggregate for the bridge abutments were also brought to the work by motor trucks and delivered at the mixer by the dealers. This material was only supplied as required, since it was not desirable to accumulate a large amount on the ground for work done during winter weather.

The main dumping ground for excavated material was about half a mile north of the tunnel and was reached by a narrow-gage construction track laid on the company's right of way. All the material excavated after getting down to the rock level was hauled to this dump. It was first intended to take practically all of the excavated material to this dump, but owing to the use of motor trucks the contractor was able to arrange with various property owners to fill in low ground along the highways and thus dispose of a large portion of the top lift, as noted above. Owing to the poor quality of the material above the tunnel and on account of its running and sliding qualities when wet none of it was permitted to be dumped into the railroad embankments. All of this material, therefore, was either wasted or used in filling low ground.

This elimination of a troublesome tunnel was planned and carried out under the direction of H. T. Porter, chief engineer, Bessemer & Lake Erie R. R., and W. S. McFetridge, principal assistant engineer, with R. Ridge

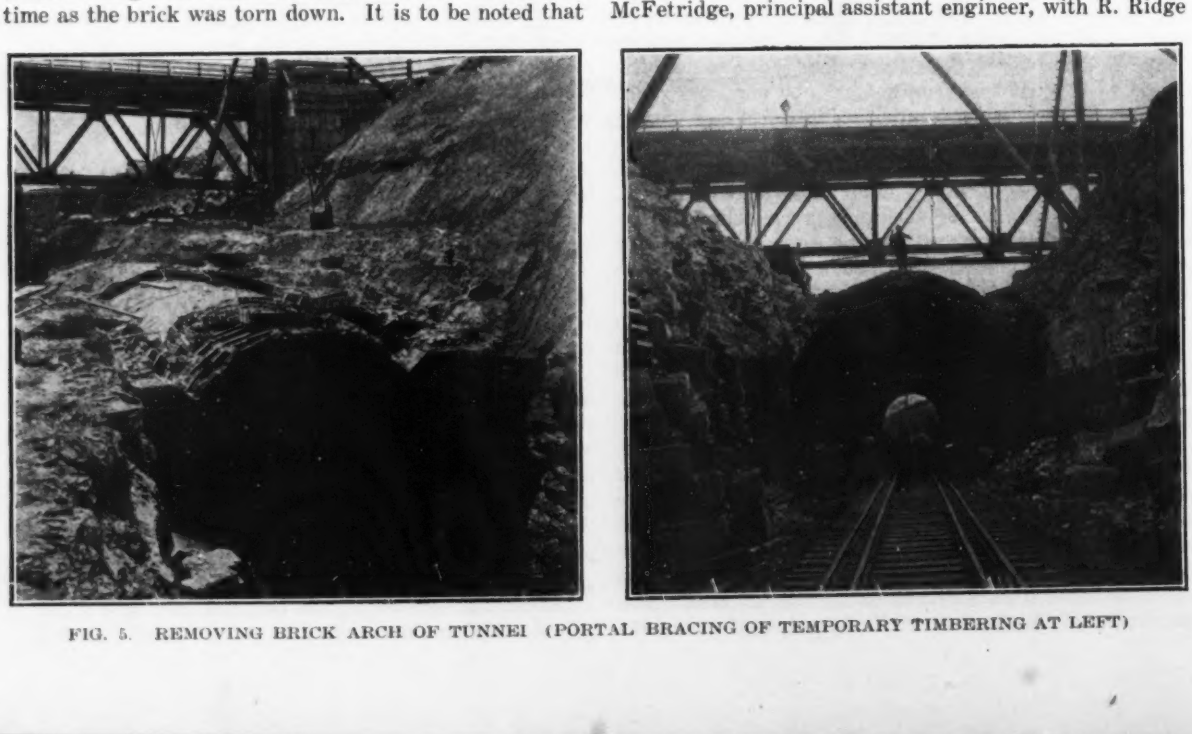


FIG. 5. REMOVING BRICK ARCH OF TUNNEI (PORTAL BRACING OF TEMPORARY TIMBERING AT LEFT)

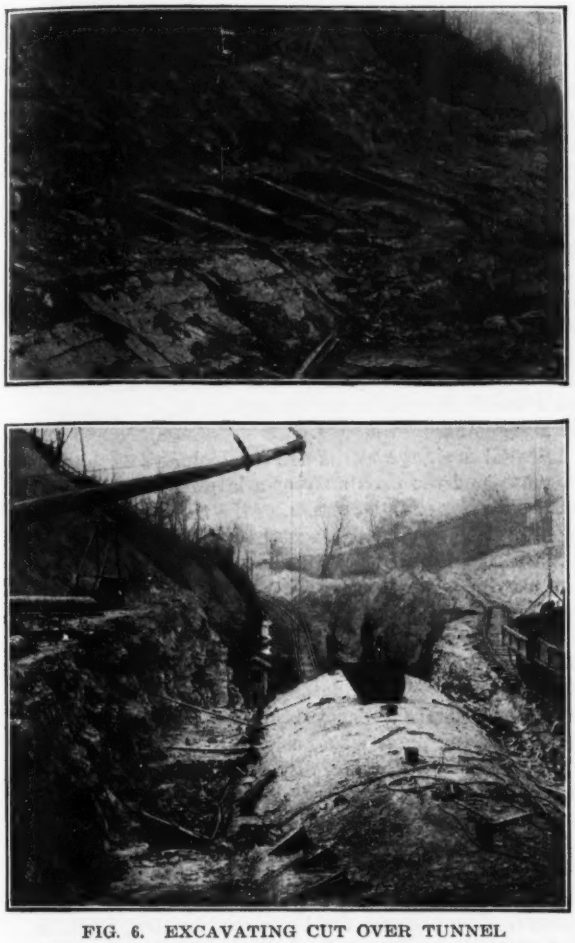


FIG. 6. EXCAVATING CUT OVER TUNNEL
Above; old exterior timbering embedded in grouting of later date. Below; old arch exposed; timbers and grouting at left.

as field engineer in charge. The general contractor is the Arthur McMullen Co., New York, with Thomas McGuire as superintendent in charge of the work. The steel highway bridge was built and erected by the American Bridge Co. This work includes the following principal quantities: 100,000 cu.yd. of excavation in the railway cut, 12,000 cu.yd. for highway changes and 2,000 cu.yd. for foundations; 142 tons of structural steel and 1,700 cu.yd. of concrete.

New Sounding Device Successful

Extensive trials of a new sounding apparatus developed at the Naval Engineering Experiment Station showed the device to be entirely successful. In this apparatus the depth of water is measured by measuring the length of time required for sound waves to travel from the ship to the ocean bottom and back. The apparatus was recently installed on the ship "Stewart." In a trip from Newport to Gibraltar, running over a course where the depths were known, the new apparatus gave results checking exactly with those obtained by sounding lead. With the old method, stopping to take soundings meant a delay of at least one hour, while the new method permits obtaining accurate depth measurements without stopping the ship. Dr. H. C. Hayes, of the technical staff of the station, who is in great part responsible for the new equipment, made the trip.

Illinois Drainage Works Involve River Control

Improve Agricultural District by Straightening Embarrass River and Building Levees and Long Diversion Ditch

By E. F. Mail
Civil Engineer, Robinson, Ill.

STRAIGHTENING a tortuous river channel and inclosing a district of some 5,000 acres by levees as a protection against river and upland flood waters are the main features of the work on the Captain Pond drainage and levee district on the Embarrass River, in Illinois. This project, shown in Fig. 1 and now underway, is characteristic of much of the work required for protecting and reclaiming rich overflow lands in the central states.

The Embarrass River, having its source near Champaign, Ill., flows in a general southerly direction, and empties into the Wabash River below Vincennes, Ind. The drainage area of 2,426 square miles has an extreme length of 110 miles, but the crooked river channel is almost twice this length. Considerable drainage and reclamation work has been done on the upper part of the river, but practically nothing on the part below Greenup. This section has more than 100,000 acres of bottom lands subject to rapid and frequent overflow. In the past ten years thousands of acres have been abandoned for farming purposes and are now grown over with brush and scrub. Below Greenup is a rather poor agricultural country, excellent for grasses and stock raising but unprofitable for corn and small grains. All the lowlands of the river are rich sedimentary deposits. The soil is exceptionally fertile and if properly reclaimed would fill the need of the adjacent country. Corn has been known to make more than 100 bushels per acre and alfalfa crops (where protected from overflow) have been extremely heavy.

Owing to the crookedness of the river (Fig. 1) effective reclamation will require a combination of levee construction and channel straightening. As the valley averages only about two miles in width this will entail a high cost per acre of land reclaimed, which is the principal cause for lack of progress in a territory where good land is needed so much. The Captain Pond drainage and levee district has its northern limits at the village of Ste. Marie (south of Greenup) and extends south for about six miles. Its land is of the richest along the river. From the north end the Embarrass River flows south and southeast to the bluffs on the east side, where it is joined by the large tributary known as North Fork. It follows the east bluff for 1¼ miles and then flows through the center of the valley to the southwest corner of the district, where it turns abruptly to the east for about a mile and then passes out of the district.

The ideal improvement would be to construct an entirely new channel along the western edge of the valley, but this was out of the question because of the necessity of caring for the North Fork. After thorough investigation of the physical features and consideration of the financial resources a plan of reclamation was adopted which includes three river cutoffs, a levee and an intercepting ditch.

River cutoff No. 1, 1,000 ft. in length across a narrow neck of land (see Fig. 1), will shorten the present course

more than ¾ mile. Cutoff No. 2, 2,000 ft., will shorten it ½ mile. Cutoff No. 3, extending south three miles, will do away with about ten miles of the most crooked and drift laden part of the river. In addition it will throw all of the land to be reclaimed on one side of the channel. This cutoff channel will be straight except for three silght curves of long radius. The average fall in new and old channels throughout the district will be 1.71 ft. per mile.

A river levee is to begin at the bluff at the northwest limits of the district and thence follow the south and west sides of the river as straightened, crossing the present channel three times. From the southeast corner it will return along the north bank, crossing the

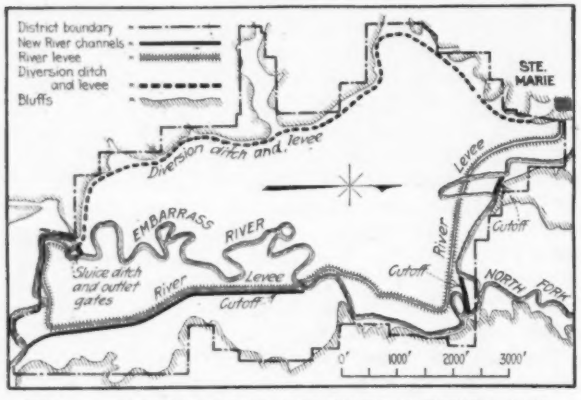


FIG. 1. CAPTAIN POND DRAINAGE DISTRICT AND LEVEE ON THE EMBARRASS RIVER, ILLINOIS

channel and joining the diversion levee. This river levee, Fig. 2, will be nine miles in length, with an average height of 11 ft. (5 ft. above known high water marks). At river channel crossings it will be constructed to a special section commensurate with its added height, as shown. Along the main cutoff the levee will average 13 ft. in height, or 29 ft. above the bottom of the new channel. It will be built of the earth excavated from that channel. Not less than 20 ft. clear berm will be left and at convex curves this will be increased to 75 ft. It is expected that the new channel will wash and widen, and that in time this section of the levee will have to be rebuilt. But half of the material excavated from the new channel will build a levee of almost twice the required section and it is believed that intelligent maintenance will preserve its utility for several years. Finally, a diversion ditch and levee along the western edge of the valley for a distance of six miles will divert all water from 21 square miles of high prairies, which water now flows over the valley and is a source of almost as much damage as the river overflows.

River cutoffs Nos. 1 and 3, which must carry the entire channel flow, have been designed for a 60-ft. bottom with side slopes 1 to 1. The average cut will be more than 16 ft. and the fall 2.65 ft. per mile. Using 0.25 for n in Kutter's formula, the bank-full flow is found to ze 8,125 sec.-ft. From gagings at the village of Ste. Marie it has been found that the carrying capacity of the present channel is 3.3 sec.-ft. per square mile of drainage area, or 6,200 sec.-ft., giving a difference of practically 2,000 sec.-ft. carrying capacity in favor of the new channel.

The river levee location is such that above and below the mouth of North Fork the width of the floodway will not be less than 1,300 ft. and 1,400 ft. respectively. These widths may be somewhat extreme for so small a stream, but it was highly desirable to avoid the error so commonly found in levee location, that of forcing the flood waters through too narrow a floodway. It was felt that a large factor of safety was more to be desired than the saving of a few hundred additional acres to the detriment of the district as a whole. Too many drainage districts have failed because of the attempted saving of every available acre regardless of the general effect on the entire project.

Sluices—A sluiceway ditch 415 ft. long from the old channel at the south end of the district will carry the rainfall run-off into the river. At the levee this ditch will have a reinforced-concrete sluice with two openings or culverts 4 ft. square, fitted with vertically sliding gates which may be closed to exclude flood water when the river is at high stages.

Internal drainage works are not included in the present plans and the proximity of a large part of the land to the old river channel precludes the necessity for many ditches. No water will reach the protected area except that which will fall as rain, and no pumping plant has been provided. Ordinarily the Embarrass River reaches the flood stage in a very short time, remains there usually three to four days (seldom more than one week) and as quickly returns to the low water flow. The old river channel will provide considerable storage during the times that the sluice gates must be kept closed, so that a pumping plant would seldom, if ever, be needed.

The mean annual rainfall on the Embarrass River drainage area during a period of twelve years was 39 in., with a maximum of 47.06 and a minimum of 30.84 in., according to a report by Jacob A. Harman on the reclamation of overflow lands in the Embarrass River valley (Bulletin No. 25 of the Illinois State Geological Survey). The greatest flood occurred in May, 1908, the maximum rainfall in one day being 4.15 in. at Robinson, Ill., on May 6, but the rainfall for that year was only 36.92 in. Run-off data for this drainage area are very limited, but gagings at Ste. Marie, Ill., in 1909-1911 showed that the capacity of the river channel when bank-full was approximately 3.3 sec.-ft. per square mile of drainage area.

Investigations in the adjacent Kaskaskia valley, which has similar characteristics and the same bank-full capacity (as reported in the bulletin noted above), showed that with water entering the valley from the entire drainage area at the rate of 25 sec.-ft. per square mile, the run-off averaged only 10 sec.-ft. per square mile, due to the storage effect of the overflowed lands. A modification of the Murphy formula, with constants adapted to conditions on the Kaskaskia, was used to give the approximate rate at which the flood waters must be carried through the valley when this "overflow" storage is eliminated by the construction of levees and channel corrections along the entire river. This formula for the Kaskaskia is given below, in which $Q =$ the run-off in cubic feet per second from 1 square mile and $M =$ the area in square miles. This same formula applied to the Embarrass River above the Captain Pond drainage district (1,865 square miles) gave 29.5 sec.-ft. per square mile or a total of 55,000 sec.-ft.

$$Q = \frac{30{,}000}{M + 200} + 15$$

For determining the velocity of flow, the method

recommended by the Harman report was followed, the floodway being divided into two parts: (1) The channel proper, including the area of the floodway immediately above and between the lines of the slopes projected to the flood plane; (2) the entire area of the floodway minus the above prism. In the Chezy formula, the value of R, hydraulic mean radius, was determined as follows: (1) For the channel prism, by dividing the area of the bank-full stage by the wetted perimeter and adding to the quotient the depth from the bank-full stage to the flood stage; (2) for the floodway outside of the channel prism, by dividing the area by the bottom plus the side slopes. In the Kutter formula a coefficient of roughness, $n = 0.025$ is recommended by the Harman reports. For the Embarrass River this was thought to give results entirely too high for that part outside the channel proper, and for that portion a value of $n = 0.035$ was used.

Assuming an extreme flood of 9 ft. above the bank-full stage (4 ft. below top of levee), the area for the channel prism is 2,044 sq.ft. and for the remainder of the floodway 11,700 sq.ft., using an average fall of 1.71 ft. per mile for new and old channels. By the Chezy formula as above outlined the average velocities are

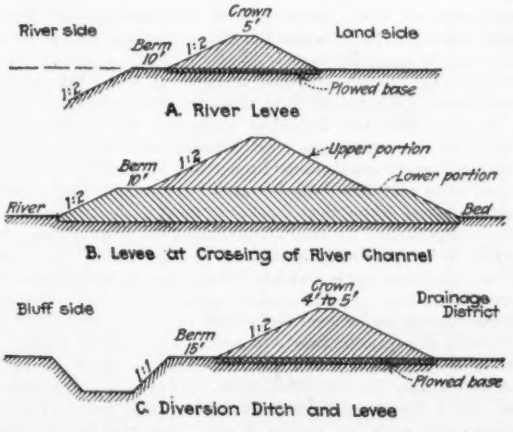


FIG. 2. SECTIONS OF LEVEES AND DIVERSION DITCH

8.06 and 3.44 sec.-ft. respectively, which give flood flows of 16,500 and 40,150 sec.-ft. respectively, or a total of 56,650 sec.-ft. As noted before, the expected maximum future flood flow is 55,000 sec.-ft. It will be many years before the flood storage in the valley above will be eliminated by the construction of new levees and channels, and even then it is doubtful if such an extreme flood will occur. Tributary streams will be improved and the maximum run-off from the lower parts of the drainage area will have reached the Embarrass and passed downstream before the crest from the upper reaches of the watershed has arrived.

Large amounts of material in suspension, carried by the river in time of flood, are deposited along the banks, with the result that the ground surface is highest along the banks and there is a considerable downward slope towards the bluffs. When the river exceeds the bank-full stage, therefore, the water spreads over the entire valley. At certain points the overflow has been so frequent and violent as to cause "washes" or "runs" through the banks and adjacent lands, sometimes denuding large areas of all productive soil. Since some of these washes are 4 to 5 ft. deep the overflow of the valley begins before the river reaches its normal bank-full stage. In the first half of 1920, the river thus spread over the valley no less than six times, although the rainfall of that season was only normal. Enormous loss resulted through the delays in preparing crops.

About 1,440,000 cu.yd. of earth will have to be moved. The total estimated cost, including clearing, bridges, right of way, incidentals and reinforced concrete sluice is $291,000, or an average of $63 per acre of land protected. This is a record figure for drainage in southern Illinois, but will permit the development of almost 5,000 acres of highly productive land. The landowners in the Captain Pond district are virtually the pioneers of the lower reaches of the Embarrass, and on the success of this district depends the future reclamation of 100,000 acres.

A contract has been let at 12c. per cubic yard and the bonds have been sold at a small discount. Some saving will be made below the estimates for bridges and sluiceway. Altogether the work now planned will be done at a saving of $40,000 to $50,000 below the estimate. The drainage commissioners and engineers plan to use part of this for a system of internal drainage and to hold the remainder for the construction of a pumping plant if it should be found necessary. E. F. Mail, Robinson, Ill., is engineer in charge of design and construction; N. D. Reed, Robinson, Ill., is consulting engineer. The W. E. Callahan Construction Co., Dallas, Tex., has the contract for earthwork and has installed two walking-type drag-line excavators with 60- and 70-ft. booms and 1½- and 2-yd. buckets.

Evil Fate Still Pursues Concrete Ships

The concrete ships built by the United States Government during the war continue to get in trouble, not through any fault of their own. As has been reported, several of the large ships have sunk, notably the "Polias" and the "Cape Fear." Several others have been in accidents, notably two of the ships built at Mobile, which ran into the breakwater at Tampico, Mexico. During the month of June additional accidents occurred. The War Department had six small concrete boats tied up in the Cape Fear River to an old dock. A storm came up, the boats pulled the dock down, and were driven downstream and bumped over sandbars. It is a good testimonial to their construction that though they were subjected to very rough treatment, none of the boats was seriously damaged. One of the hulls developed a slight crack in the concrete above the water line, but repairs in each case can be made including the damage done to the fenders for less than $800.

One other small boat, the "General Wilkins," a 125-ft. army transport built after the war from designs made during the war ran ashore on a submerged boulder on the Long Island coast. Two holes were made in the hull, one penetrating to the forward end of the engine room and one to the cargo space, and the boat went down in 9 min. There was no damage to the concrete other than at the points where the boulder struck, but oil tanks were penetrated and the oil caught fire, burning the entire wooden superstructure of the boat. These War Department boats were built to carry small numbers of troops to island coasts near the mainland.

# Indicates Lines of Attack on Industrial Waste

Hoover Discusses Problems of Quantity Production, Twelve-Hour Day, Intermittent Employment, and the Business Cycle

Extract from address before the National Conference of Social Work, Providence, R. I., June 27, 1922.

ONE of the problems in which there is much discussion is that of the hours of labor. In any discussion of this subject, we must embrace three points of view—the engineer's, the economist's, and the social student's. Both the engineer and the economist must insist on the maximum productivity. For the maximum production is the only foundation on which we can obtain more general higher standards of living. The argument is simple enough, for the more cheaply commodities can be produced, the larger are the number of people who can participate in them.

The Problems of Quantity Production—The engineer however, does not advocate unlimited hours; he does not obtain the maximum production when fatigue and deterioration in product begin to supervene. His view of human fatigue and of human deterioration leads directly to the restriction of hours to that number that will permit of best performance and efficiency in the tasks in the long view. The engineer takes more than the immediate view of a day's work, for there are some tasks of repetitive character which tend to intellectual and moral deterioration in the long run. It is one of the first problems in front of the engineer to find such a diversion and stimulation to intellectual interests either directly in the task itself or indirectly in some association with it that will prevent not only fatigue but deterioration itself. While this problem is of high importance, I am not one of those that thinks that the fabric of the nation is about to collapse because we have developed mechanical tools for mass production, for the very minor malign results that have accompanied these inventions can be overcome. The length of hours of labor in the vision of the engineer will vary with every task. There are many tasks in which four hours is too long for continuous action. There are other tasks such as that of the caretaker of an empty house where twenty-four hours, six days in a week, would not be absurd from a physical point of view.

The social student must approach the question from another and equally vital point of view, and that is family life, citizenship, and opportunity for recreation and intellectual improvement. These limitations are mandatory, and whatever the right hours may be as between these vital social limitations and the limitations imposed by the view of productivity, it is a certainty that the twelve-hour day or seven-day week cannot be entertained by any well-thinking social student. We have set up as a matter of public sentiment eight hours as an approximate standard, yet no empirical number can be right. The engineer is the proponent of scientific study into the hours in which maximum productivity can be obtained and maintained. We need these studies by the engineer and social student in every industry, for hours too short are an injury to the rest of us in that they impose lower standards of living upon us; and hours too long are injurious to the individual, thereby the race.

The Twelve-Hour Day—The President recently called a meeting of the leading steel manufacturers of the country and made an appeal to them in the name of social progress that they should take steps to abolish the twelve-hour day which now remains in respect to about fifteen or twenty per cent of the employees in that industry. For competitive reasons this abolishment needs be brought about coincidently in the whole industry and the President's action gains this opportunity for united action. This request was based solely upon social grounds and indeed the social necessity is sufficient justification for this or any other step. Many employers are in favor of it and I trust that this great step will be quickly brought about. I do not believe it is possible to develop proper citizenship or proper family life, whether men work twelve hours by necessity or by preference. And I think you will agree with me that 90 per cent of the public opinion of the entire country is solidly behind the President in his expression that we have now reached a stage of social conceptions wherein this anachronism should be abandoned.

Intermittent Employment—The industrial losses through unemployment and intermittent employment constitute a problem that is not to be solved by any formula. It must be attacked in detail. There are phases of our seasonal employment that no doubt could be mitigated by more co-operation in industry. There is one feature now being given consideration in many directions that I believe is of interest and promises ultimate results, and that is the accurate study by civic bodies of the character of the particular industries in any particular center in the endeavor to discover opportunity for integrating industries to intermesh with each other in reduction of seasonal idleness. Every city in the United States would be well advised in the interest of its own development to consider its industries with view to a determination of what industries might be introduced that would take up the slack in seasonal employment of their already existing establishments.

The Business Cycle—One of the tremendous wastes through unemployment is due to the fluctuation of the business cycle. We are constantly reminded by some of the economists and business men that this is inevitable; that there is an ebb and flow in the demand for commodities and services that cannot from the nature of things be regulated. I have great doubts whether there is a real foundation for this view. Thirty years ago our business community considered that a cyclical financial panic was inevitable. We know now that we have cured it through a Federal Reserve Banking system. We know also that many of our industries are themselves finding methods for insuring more continuous operation of their plants during these ebbs and flows of demand. At the present moment a committee of important business men and economists, with the co-operation of the Department of Commerce, are engaged in a systematic study of this problem. An analysis of the business cycle quickly brings one to the separation of our production of consumable goods from the construction of our plant and equipment, that is, our houses, our public utilities, our public improvements, our public works. The ebb and flow of demand for consumable goods probably in the main may be uncontrollable. There is more hope that we could direct certain branches of our construction and equipment, such as public works, the greater utilities, in such a fashion that we could provide the finances and then delay construction until periods of depression, and thereby shift our labor from consumable goods to plant and equipment in these periods. It would clip the top from booms and the depression from slumps.

It has been calculated that if we could secure a delay of such equipment to the amount of one-tenth during the period of normal business in the great utilities and construction works under the control of the Government that it would almost plane out the depression in employment. I am confident that there is a solution somewhere, and its working out will be one of the greatest blessings yet given to our economic system—both to the employer and the employee. And there is nothing that would contribute so much to the contentment and the advancement of our people as assurance of a reasonable economic security.

To Assess Water Main Costs at Hartford

The cost of water main extensions at Hartford, Conn., is to be assessed against abutting property owners in accordance with an ordinance recently adopted by the city council. The assessment is to be based directly upon the frontage with a deduction of 75 ft. for corner lots. The amount assessed shall be in no case in excess of the average cost to the Board of laying 6-in. pipe during the preceding calendar year.

Making Load Tests of a Tile Wall and Measuring Floor Deflections

By Edward Godfrey
Structural Engineer, Pittsburgh, Pa.

In a recent investigation of a building where concentrated loads were placed on tile walls it became necessary to ascertain whether or not the provision for distributing the load into the wall was adequate. The case was one where interior tile walls were used as bearing walls carrying concentrations computed to be 22,600 lb. The walls were 13 in. thick and 12 ft. high. The method of distributing the concentrated load was by building brick blocks or saddles about 2 ft. long, as thick as the wall and about 28 in. high. A concentration of 22,600 lb. meant a load of about 380 lb. per sq.in. of net tile area.

It was considered that if there was a factor of safety of four, the construction would be accounted safe. Hence it was decided to apply a load twice as great as the computed concentrated load, on an area of wall half as large as the base of the brick saddles.

A specially designed rigging, used to hang the load from the wall, proved so satisfactory a means of testing that a description may be of interest to engineers in general. The accompanying sketch, Fig. 1, illustrates the manner in which the load was applied, and the view, Fig. 2, shows the test during loading and at completion. The purpose of the 4 x ½-in. steel plate was to prevent the steel beams, if they should rock, from bearing on the corner of the 12-in. steel plate, thus creating a high intensity of pressure at the edge. The bricks which constituted the loading were laid in close rows on edge on the loading platform, symmetrically on each side of the wall (the number of bricks in the layers being counted). One hundred bricks were weighed to ascertain the average weight.

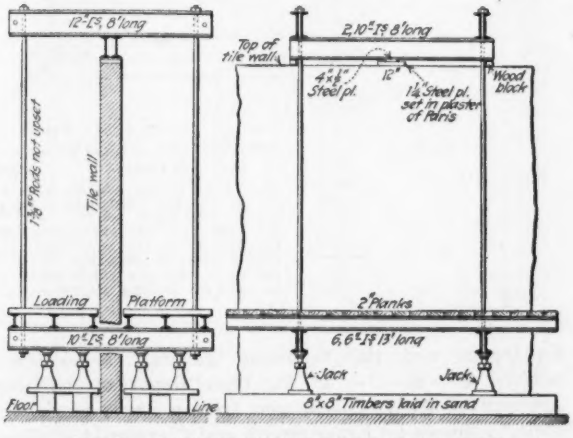


FIG. 1. HANGER RIGGING FOR WALL TEST

The eight screw jacks under the platform supported the load while it was being placed, but when these jacks were released the entire load was supported by the 12-in. steel plate on top of the wall. The channels passing through the wall had ample clearance, and the 10-in. I-beams along the top of the wall were free at the ends, though as a safeguard wooden blocks were placed under them so that in case the wall should crush the beams could fall only ½ in. or tilt to this amount. To prevent the upper beams from falling if the wall failed, scaffolding was built to catch them.

When a considerable portion of the load was placed, and a count showed a balance, the jacks were released, causing the load to be transferred to the top of the wall. This was repeated a number of times so as to catch the capacity load, and when the total load amounted to 47,174 lb. it was considered that the wall had been fairly tested. This load was allowed to hang on the wall for several minutes, the jacks being all released for that time.

The tile wall tested indicated by inspection that the mortar joints were good, hence no apprehension was felt as to the result of the test.

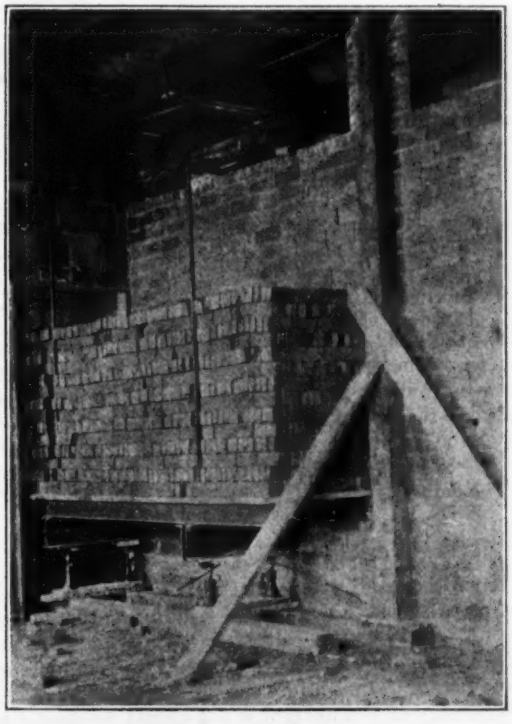


FIG. 2. LOAD ON WALL SAFEGUARDED BY JACKS

Floor Deflection Gage—In connection with the same investigation floor tests were made. In these tests I hit upon a method of measuring deflections which gave very satisfactory results and required no special apparatus.

The deflection at the middle of a floor space tested was measured by means of an Ames dial. This dial was fastened by means of a screw on an upright 4 x 4-in. timber, as shown in Fig. 3. The movable column of the dial was set in contact with the ceiling under the floor where the test load was being placed. The upright timber was braced against motion all ways, and a ladder was placed where access could be had to the dial when it was desired to take readings.

There was only one Ames dial on hand, and on one occasion it was desired to measure the deflection over a wide door opening as well as that in the middle of the floor. I asked the contractor's foreman to get a stick to measure the ceiling height, so that we could rig up a scheme to measure this deflection approximately. He

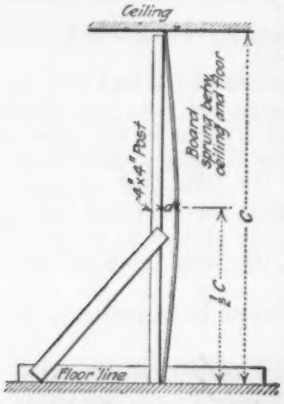


FIG. 3. FLOOR DEFLECTION MEASURED BY BENT STRIP

brought a stick that was just a little longer than the ceiling height. I told him that was just what I wanted, and that we would just cut that stick so that it would have a little bow, and any deflection in the ceiling would increase that bow. This increase could be readily measured from the floor, and by a simple calculation the vertical deflection could be found. We, of course, had the door opening, in this case, across which a stick was nailed to measure the middle ordinate of the curve; but in the middle of a floor an upright 4 x 4-in. timber can be set up and braced, and beside this the bowed stick can be placed.

To make the calculation for the deflection the following formula is made use of: Where L = length of arc, C = length of chord, and D = middle ordinate of arc,

$$\text{Difference between } C \text{ and } L = \frac{8d^2}{3C} \text{ or } \frac{8d^2}{3L} \text{ very nearly.}$$

In this case C is the ceiling height and L is the length of the stick. The actual value of the difference between C and L is of no consequence, but the difference between the initial and final difference is the deflection. If d and d' are the initial and final readings of the middle ordinate of the curve, in inches, the deflection D in the ceiling is,

$$D = \frac{8}{3C}(d'^2 - d^2)$$

It will be readily seen that the smaller the value of d the more accurate will be the reading of the deflection. If, for example, the ceiling height is 12 ft. and the initial offset of the curve (d) is 1 in. an increase in the offset of ¼ in. means .005 in. deflection.

The edge of the upright 4 x 4 should be straight and the board that is sprung between floor and ceiling should be uniform in section and quality. The bowed stick should not be heavy enough to carry any appreciable floor load. A piece of 4 x ¾ in. was used in this test.

Development of Drainage in U. S.

According to recent figures of the Bureau of The Census, there were on January 1, 1920, 65,495,038 acres of land in the United States in organized drainage enterprises, either operating or under construction. These figures emphasize the extent to which agricultural drainage has become a community problem in this country. Practically all the states in which there is sufficient wet land to justify it have now enacted laws providing under certain conditions for the organization of lands into drainage districts. These laws provide for a permanent organization which is endowed with power to condemn property needed, to borrow money and issue bonds, to assess and collect drainage taxes, to construct whatever improvements are necessary to accomplish the drainage of the district, and in short to perform any and all acts required for the successful carrying out of the project.

The California Pipe Method of Water Measurement

By Blake R. Vanleer
Assistant Professor of Mechanical Engineering, University of California, Berkeley, Cal.

THERE is need for a method of measuring water which the man on the job can use with the ordinary tools at his disposal. The method described below offers a solution to this problem for the irrigation farmer, the man operating dredge pumps and many others where the discharge of the water is not submerged or under pressure.

The necessary apparatus consists of: a tee (same size as the discharge pipe); nipples; a spirit level; a 2-ft. carpenter's rule.

Principles—The "California pipe method of water measurement" is based upon the principle that if water is delivered to a short pipe nipple with a zero or at least a very small velocity head, then for the same size pipe and the same quantity, the depth of water in the pipe will always be the same.

Apparatus similar to that shown in Fig. 1 was set up in the Hydraulic Laboratory of the University of

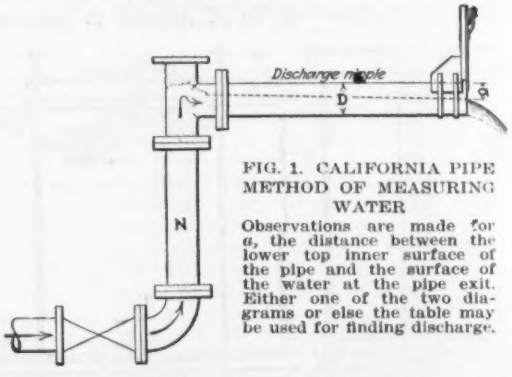


FIG. 1. CALIFORNIA PIPE METHOD OF MEASURING WATER
Observations are made for a, the distance between the lower top inner surface of the pipe and the surface of the water at the pipe exit. Either one of the two diagrams or else the table may be used for finding discharge.

California and the following general formula was derived, $Q = K\,(D - a)^{1.88}$. (See "Report on the Measurement of Water Discharged from a Short Horizontal Pipe," a thesis by Ejnar Smith and Clarence A. Pollard, submitted in partial satisfaction of the requirements for the degree of B. S. in Mechanical Engineering at the University of California, May, 1921.) In this formula

Q = The quantity in second-feet.
K = A constant depending upon the diameter of the pipe, in this general case, $K = (0.0116 + 0.00787D)$.
D = The diameter of the pipe in inches.
a = The distance in inches from the upper inside surface of the pipe to the surface of the flowing water measured in the plane of the discharge end of the pipe.

The formula has been checked by experimentation with pipe up to 6 in. in diameter and has been found to be quite accurate. The error was at all times less than 5 per cent.

Operation—The apparatus is set up as shown in Fig. 1. The length of the discharge nipple should be at least six times the diameter of the pipe. The exact length is immaterial so long as the nipple is not so short as to make the measurement of the distance, a, very difficult and hence inaccurate. The nipple, N, may have

CALCULATED VALVES FOR CALIFORNIA PIPE METHOD OF WATER MEASUREMENT

	D Pipe Diameter, In.	a Dist. from Upper Edge, In.	D–A In.	K 0.0116+ 0.00787d	Q Quantity, Sec.-Ft.
Nominal	3	2.75	0.318	0.0352	0.014
Actual	3.068	2.50	0.568		
		2.25	0.818		0.026
		2.00	1.068		0.040
		1.75	1.318		0.055
		1.50	1.568		0.076
		1.25	1.818		0.099
		1.00	2.068		0.128
		0.75	2.318		0.158
		0.50	2.568		0.193
		0.25	2.818		0.231
Nominal	4	3.75	0.276	0.0432	
Actual	4.026	3.50	0.526		0.0124
		3.25	0.776		0.0253
		3.00	1.026		0.0436
		2.75	1.276		0.0651
		2.50	1.526		0.093
		2.25	1.776		0.123
		2.00	2.026		0.156
		1.75	2.276		0.194
		1.50	2.526		0.238
		1.25	2.776		0.285
		1.00	3.026		0.333
		0.75	3.276		0.388
		0.50	3.526		0.441
		0.25	3.776		0.498
Nominal	6	5.75	0.25	0.0588	
Actual	6.065	5.50	0.50		0.0161
		5.25	0.75		0.0342
		5.00	1.00		0.0588
		4.75	1.25		0.090
		4.50	1.50		.126
		4.25	1.75		.168
		4.00	2.00		0.208
		3.75	2.25		0.270
		3.50	2.50		0.330
		3.25	2.75		0.392
		3.00	3.00		0.463
		2.75	3.25		0.540
		2.50	3.50		0.620
		2.25	3.75		0.701
		2.00	4.00		0.793
		1.75	4.25		0.879
		1.50	4.50		0.987
		1.25	4.75		1.082
		1.00	5.00		1.183
		0.75	5.25		1.283
		0.50	5.50		1.388
		0.25	5.75		1.494
Nominal	8	7.75	0.321	00.0751	
Actual	8.071	7.50	0.571		0.0252
		7.25	0.821		0.0505
		7.00	1.071		0.083
		6.75	1.321		0.124
		6.50	1.571		0.173
		6.25	1.821		0.225
		6.00	2.071		0.290
		5.75	2.321		0.361
		5.50	2.571		0.434
		5.25	2.821		0.522
		5.00	3.071		0.610
		4.75	3.321		0.715
		4.50	3.571		0.810
		4.25	3.821		0.930
		4.00	4.071		1.03
		3.75	4.321		1.16
		3.50	4.571		1.27
		3.25	4.821		1.42
		3.00	5.071		1.55
		2.75	5.321		1.71
		2.50	5.571		1.85
		2.25	5.821		2.02
		2.00	6.071		2.17
		1.75	6.321		2.37
		1.50	6.571		2.52
		1.25	6.821		2.72
		1.00	7.071		2.90
		0.75	7.321		3.08
		0.50	7.571		3.30
		0.25	7.821		3.50
Nominal	10	9.75	0.27	0.0904	
Actual	10.02	9.50	0.52		0.0264
		9.25	0.77		0.0553
		9.00	1.02		0.094
		8.75	1.27		0.140
		8.50	1.52		0.162
		8.25	1.77		0.216
		8.00	2.02	0.0904	0.339
		7.75	2.27		0.420
		7.50	2.52		0.512
		7.25	2.77		0.609
		7.00	3.02		0.722
		6.75	3.27		0.88
		6.50	3.52		0.96
		6.25	3.77		1.08
		6.00	4.02		1.22
		5.75	4.27		1.37
		5.50	4.52		1.54
		5.25	4.77		1.69
		5.00	5.02		1.87
		4.75	5.27		2.04
		4.50	5.52	0.0904	2.25
		4.25	5.77		2.43
		4.00	6.02		2.64
		3.75	6.27		2.88
		3.50	6.52		3.10
		3.25	6.77		3.32
		3.00	7.02		3.58
		2.75	7.27		3.79
		2.50	7.52		4.08
		2.25	7.77		4.32
		2.00	8.02		4.59
		1.75	8.27		4.87
		1.50	8.52		5.17
		1.25	8.77		5.41
		1.00	9.02		5.74
		0.75	9.27		6.04
		0.50	9.52		6.35
		0.25	9.77		6.68

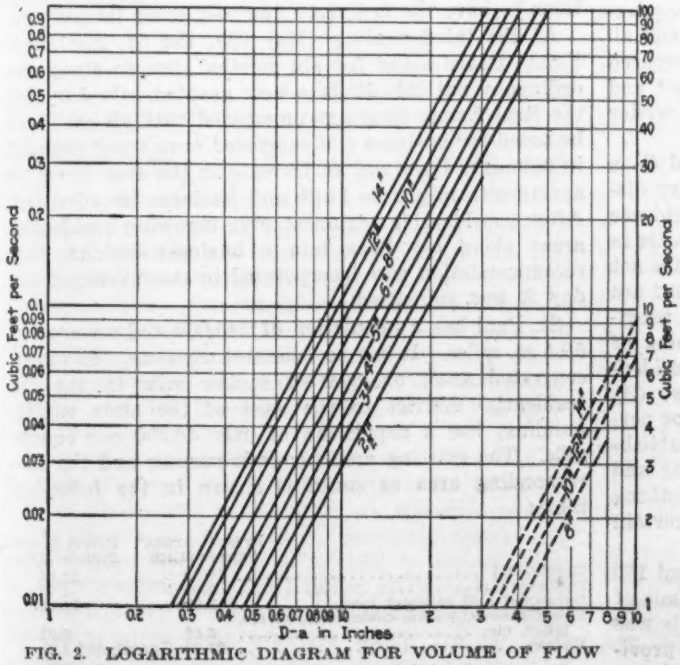


FIG. 2. LOGARITHMIC DIAGRAM FOR VOLUME OF FLOW

Based on $Q = K\ (D - a)^{1.88}$. Use left-hand scale with the solid lines and right-hand with dotted.

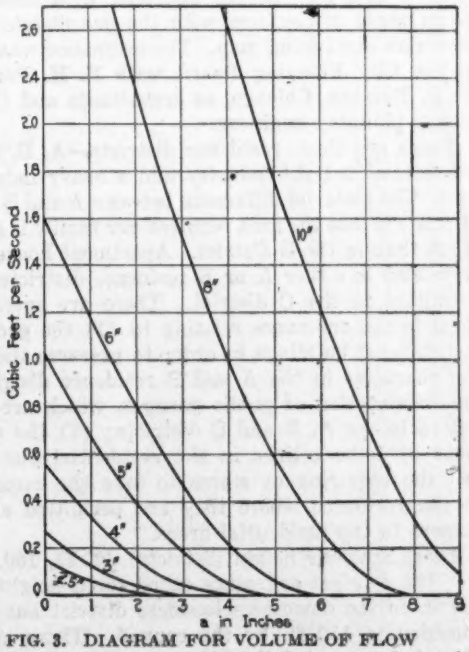


FIG. 3. DIAGRAM FOR VOLUME OF FLOW

Quantities for values of a instead of $D - a$ plotted on ordinary cross-section paper.

any convenient length. Its purpose is to allow the water to approach the discharge nipple with a very small velocity of approach and as little turbulent flow as possible. The tee is used not only to turn the direction of the water but also to allow free access of air into the discharge nipple. The discharge nipple must be level and horizontal and under no circumstances must it be permitted to run full of water, as the formula does not hold for this condition for obvious reasons.

After the water flowing through the apparatus has become steady the distance, a, may be measured with any ordinary rule. Substitution may then be made in the general formula and the quantity in second-feet will be given. The distance a should be measured as accurately as possible, but on most work the nearest $\frac{1}{32}$-in. will be sufficiently accurate.

This apparently has not simplified the problem very much because substitution in the formula $Q = K\ (D - a)^{1.88}$ involves not only a knowledge of the formula but also the ability to use logarithms, which necessitates either a slide rule or a table of logarithms. This will not help the man on the job. So, for his benefit Fig. 2 has been prepared. This shows D-a plotted as abscissae on logarithmic paper against Q, quantity in second-feet as ordinates. The method of use of these curves is obvious.

For those, however, who are not accustomed to the use of logarithmic paper Fig. 3 has been prepared. These curves give the relation between the distance a and the quantity Q, in second-feet. For those who do not like to use charts the accompanying table has been prepared.

Zoning Ordinance Adopted by St. Paul, Minn.

By George H. Herold
City Plan Engineer, St. Paul, Minn.

THE zoning ordinance adopted by the city council of St. Paul, Minn., July 7, provides for six use districts and four height districts, with area requirements made to conform with the use districts and all shown on one zoning map. The ordinance was prepared by the City Planning Board, with E. H. Bennett and W. E. Parsons, Chicago, as consultants and the writer as city planning engineer.

There are three residence districts—A, B, and C—a commercial, a light industry and a heavy industry district. The material difference between A and B residence districts is that the area required per family is greater in the A than in the B district. Apartment houses are not permitted in either A or B residence districts, but are permitted in the C district. There are special provisions in the ordinance relating to (1) the grouping of institutional buildings in order to preserve the residential character in the A and B residence districts; (2) the construction of public garages, which are not permitted in the A, B and C districts; (3) the establishment of setback lines in the residential districts and (4) the requiring of stores to take the same setback as the residence where they are permitted at certain corners in the residential areas.

There are four height districts: 40, 75, 100, and 150 ft. The original ordinance called for a height limit of 120 ft. in the downtown business district but this was amended to 150 ft. by the council. There are provisions for increasing the height in each district for each foot the building is set back, as follows: In the 40-ft. district, 1 ft.; 75-ft. district, 2½ ft.; 100-ft. district, 3½ ft.; 150-ft. district, 4 ft.

The zoning ordinance was authorized by the State Legislature, Chap. 217, Session Laws of 1921. It provides for zoning under the police power. A Board of Zoning is established, consisting of five members of the City Planning Board and the city architect. Provisions are made for amending the ordinance upon petition of 50 per cent of the owners of the frontage after review by the Board of Zoning and approval by a two-thirds majority of the City Council.

The field work on the zoning ordinance began in May, 1921, and the ordinance was presented to the City Council on April 26. A complete field survey was made to determine the use of every piece of property in the city, and these uses were noted by symbols on a new map of the city prepared by the City Planning Board on the scale of 500 ft. to 1 in. Setbacks, height of building, etc., were also determined by the survey. Upon this was built up the zoning map.

No public hearings were held on the ordinance before its introduction in the council, but considerable publicity work was done by presenting the general principles of zoning to all clubs and civic organizations and through the newspapers, and in some cases exhibiting the tentative zone plan. All newspapers of the city backed the zoning ordinance and the City Planning Board.

The ordinance required four readings before the Council, and on these dates, which were published, a few objectors appeared. It was the viewpoint of the City Planning Board and of the Council that public hearings would develop individual opposition only, and that as a zoning ordinance was for the good of the greater number and being done under the police power that individual objectors should not influence the plan. Ample provision, however, was made in the ordinance to permit those who felt aggrieved to present evidence and petitions to have the ordinance amended after its passage.

At the third reading (May 23), the St. Paul Real Estate Board asked for six months' time to study the ordinance, but only 30 days were granted. On June 30, the Real Estate Board recommended that all car lines be zoned for business and suggested some small changes in boundary lines and an increase in the area in which apartments might be built and business be admitted. After considerable argument over throwing residential areas along car lines into a business district, this recommendation was incorporated in the ordinance the day it was submitted.

St. Paul has a population of 240,000 and an area of 55.4 sq. miles. It has no tenement districts. The most congested area, one-quarter square mile in the old residential district to the west of the state capitol building, has a population of only 40,000 per square mile. The existing area for each purpose and the corresponding area as zoned is shown in the following table:

	Present Areas Square Miles	Zoned Areas Square Miles
Residential	17.20	31.05
Business	0.90	1.78
Industrial and railroad land	3.80	12.10
Miscellaneous, parks, cemeteries, rivers, lakes, etc.	6.42	6.62
Vacant	27.08	Unassigned 3.85
	55.40	55.40

Mixer Performance on Illinois Road Work in 1921

Few Mixers Work Over One Hundred Days—Central Proportioning Plants Predominate —Double Shifts Prove Efficient

ONLY five contractors laid pavement on more than 100 days in building concrete road in Illinois in 1921. The maximum number of days on which any mixer worked was 127. A total of 102 mixers were operated and every day was counted on which the mixer worked any considerable portion of the time. Of the 102 mixers, 20 were operated with central proportioning plants and industrial railway delivery; 34 were operated with central proportioning and truck delivery; 28 were operated with material strung along the subgrade; 8 were operated from large storage piles at intervals along the road, and 12 were central mixing plants, with wet-batch delivery by trucks. Altogether 111 contractors had paving contracts during the year.

ROAD WORK AT NIGHT IN ILLINOIS

An output comparison of the five general types of plant gives the figures in Table I.

TABLE I.

Type of Plant	Number Outfits	Days Worked	Total Footage	Av. Ft. Per Day
Industrial Ry., central proportioning	42	1,478	623,403	421.8
Truck, central proportioning	51	1,731	581,345	335.9
Truck, central mixing	18	623	237,059	380.5
Truck, large storage piles	10	350	128,306	366.6
Stock piles along subgrade	20	521	128,662	246.9

Comparison only in a very broad way is safe. As might be expected the wheelbarrow gangs charging from stock piles strung along the subgrade show the smallest output. The output of the industrial railway plants averages higher than that obtained by any of the methods employing truck haulage. The significant part is that the average daily output per outfit for all methods was 361 ft. per day worked, of 7-8-7-in. pavement 18 ft. wide.

A record of the outputs of 68 contractors based on the sizes of mixers used is given in Table II. Obviously some of the records in this table are abnormal because of the short runs or an output for some reason very much smaller than there is a right to expect under ordinary conditions. The number of these abnormal records, however, is not large enough seriously to affect the comparative daily averages which are set forth in Table II.

TABLE II

Size of Batch	Total Days	Total Footage	Feet per Day
Two-bag	176	28,757	163
Three-bag	265	69,224	261
Four-bag	3,559	1,233,766	347
Six-bag	256	95,450	372
Eight-bag	428	191,198	446

In examining all the figures in and derived from Table III the fact must be kept in mind that the mixers include those at central mixing plants and others at portable plants as well as mobile paving mixers. Some large daily and weekly yardages were recorded. On June 16, W. F. Smith, working a single shift laid 1,434 ft., or 2,549 sq.yd. and in the week Aug. 15-20, Jansen & Schaefer, working double shift laid 5,985 ft. or 10,650 sq.yd.

Double shifts were worked by a number of contractors and about 0.8 times the footage of the day shift was secured. As fewer men were employed on the

TABLE III—AVERAGE DAILY OUTPUT OF DIFFERENT SIZE MIXERS FOR 1921

Contractor	Days	Feet Completed	Average Feet Per Day
Two-Bag Batch			
Cole & Fauber	34	9,237	271
Miller & Comstock	32	3,178	100
A. C. Loomis	2	265	132
F. T. Williams	56	10,336	184
E. C. Trowbridge	14	1,063	75
Day Labor	38	4,679	123
Three-Bag Batch			
Albert Fahrig	34	6,936	204
R. H. Rhoades	25	6,960	278
Str. Cotton Co.	79	18,212	230
Chicago Heights Coal Co.	21	7,779	370
J. J. Dunnegan	29	9,800	337
Keokuk Q. & Const. Co.	4	323	80
Stocker Gravel Co.	54	15,137	280
Powell & Gauen	19	4,067	214
Four-Bag Batch			
R. F. Conway	345	147,135	411
Jansen & Schaefer	149	82,032	550
Cameron, Joyce & Co.	173	52,241	303
Arnold & Co.	60	20,117	334
J. W. Etchison	100	37,251	373
Jos. Kesl & Sons	38	15,067	396
Miller & Comstock	20	8,501	425
Fred C. Nelson	50	33,257	554
Federal Paving Co.	181	56,545	312
W. A. Jaicks	181	57,589	318
Vermilion Co. Board	140	50,576	361
C. W. Clark	57	15,658	274
Barnes & Verhey	53	18,228	343
R. P. Devine	15	8,248	549
C. L. Porter	23	7,427	322
Hans. Jensen	22	3,723	169
Ill. Hydraulic Co.	45	6,158	136
B. F. Walters	34	6,100	179
St. Clair County	76	15,665	206
J. A. Shockley	19	7,603	400
Eclipse Const. Co.	61	16,579	271
W. A. Black	17	5,100	300
S. A. Cunningham	27	3,226	119
Henry Horst	15	4,921	328
Jas. Black Mas.	252	106,314	421
H. H. Hall Const. Co.	131	46,801	357
C. E. Carson	63	21,280	337
C. J. Morits	82	36,652	446
A. J. Parrish	168	87,638	521
Force Account	125	41,278	330
J. J. Dunnegan	108	49,642	459
W. D. Lonergan	31	133,325	429
Warner Const. Co.	30	6,843	228
Trompeter & Sons	75	18,903	252
Rockford Const. Co.	26	7,627	293
Milburn Bros.	91	36,959	406
Farmer & Laing	11	1,742	158
H. Pfizenmayer	20	4,400	220
Hug. Lumber & Const. Co.	119	51,152	429
Shanks & Gannon	16	5,898	368
C. E. Gierts & Sons	49	17,137	349
Van. D. & Baumberger	6	1,119	186
Hedges Const. Co.	30	8,698	289
N. B. Ridge	32	8,534	266
John Darrow	24	5,280	220
M. Hayes & Sons	63	28,700	455
Macon Co. Board	58	27,496	470
Paschen Bros.	30	11,401	380
Six-Bag Batch			
Jas. Black	78	35,775	458
McCall Const. Co.	88	26,817	304
Force Account	90	32,858	365
Eight-Bag Batch			
W. F. Smith	76	38,816	510
J. O. Heyworth	184	80,709	438
Powers & Thompson	168	71,673	426

night shift it was figured as nearly 100 per cent efficient compared with the day shift. On some operations Delco lighting outfits were used and on others carbide lights. A night photograph taken by F. L. Dunavan and reproduced here shows a carbide-light operation by R. F. Conway Co., Chicago. This contractor used a No. 21 mixer charged with proportioned batches delivered in light trucks. The fine grading and the form setting for the night work was done during the day shift, as satisfactory work could not easily be secured by artificial light. Carbide flood lights were used, placed about 20 ft. apart and carried ahead as the work progressed.

On this operation the surface secured at night is stated to be just as perfect as that secured on the day shift. In fact variations in surface were emphasized by the artificial light and were more easily discerned and corrected. The greatest difficulty was with stone pockets as the water filled these and gave the appearance of a perfect surface. Less care, however, was required at night to keep the surface from drying too rapidly.

New Studies of Stress Distribution in Irregular Members

By George Paaswell
Construction Engineer, New York City

SOME illuminating data on the complex stress distributions occurring in irregular-shaped members are contained in a report of a committee of the British Association presented at the annual meeting of the association last September and just published. Engineers already have available a vast fund of information on the elementary stress distributions in structural units of simple form, but little that is effective has been done on the more complex distributions of stresses in odd-shaped members. However, research has received a powerful impetus through the introduction of the methods of photo-elasticity: study of the polarization of light transmitted through a stressed transparent member. Celluloid behaves very much like steel under stress, and is transparent, making an ideal material for the test. Some of the work reported by the committee deals with tests of this kind. Prof. Coker, chairman of the committee, has been working in this field for some years, and earlier results of his investigations were published in the *General Electric Review*, Vol. XXIII, p. 870.

Engineers have long recognized that cracks, notches, holes, and the like in a member produce local weakness exceeding the reduction of section. Of the nine papers included in the committee report, three treat of the observed effect of notches and holes.

Effect of Notches and Holes—At a discontinuity, say a notch or a re-entrant angle in a simple tension member, stress concentrates at an alarming rate. If the material is ductile, as soft steel, the concentrations are ironed out by the time failure is reached, so that rupture generally takes place at the weakest section of the member in accordance with ordinary calculation. But in brittle material the stress concentrations persist until failure occurs at the discontinuity. In a short specimen the complex stress distribution extends throughout the entire member and it may happen that no cross-section of a tension member exhibits pure tension. Under these conditions it appears to be possible that great irregularity of stress distribution may exist in a composite structural section, due to the method of assembling the elements or due to variations in the modulus of elasticity. Notch effects are particularly marked with relation to impact, when the stress concentration depends upon the sharpness of the fillet in the notch; stresses as high as six times the mean have been noticed when the fillet radius was very small. It follows that low working values must be used in designing parts with such notches subjected to impact in service.

Bearing on the justifiability of comparing celluloid and steel, one of the papers deals with the theory of stresses in a flat member (in a plane). If one or more holes exist in such a plate, the stress formulas contain the elastic constants, while in a plate without holes the elastic constants disappear from the formulas. However, it is now shown by the committee report that the elastic constants play only a minor part in the formulas applicable to plates with holes, so that for practical purposes the constants may be neglected. Thus, the difference of elastic constants in different materials does not affect the results, and a study of stresses in a celluloid model is therefore applicable to materials other than steel.

Effect of Surface Flaws—In the fourth paper it is pointed out that while theory indicates high stress concentrations due to minute surface imperfections (such as small scratches) actual tests do not show them. Apparently the surface imperfection must bear a comparable ratio to the overall dimension of the member; minute flaws do not produce structural weakness, while large flaws produce the weakness that theory indicates. It is observed by the committee that minute surface flaws may lack apparent effect because the material already has unobserved flaws which reduce the ideal strength. Experiments were made on a glass model that normally gave a tensile strength of 25,000 lb. per square inch, and it was found that by treating the material so as to remove all possible flaws a strength as high as 900,000 lb. per square inch could be developed. Taking a "perfect" specimen so produced, and giving it a light finger tap, thereby producing a flaw so small as to be unobservable even under 250 magnification, the effective strength was reduced to one-eighth that of the "perfect" specimen.

Distribution of Stress in a Flanged Pipe—One of the papers deals with stresses in a flanged pipe, and by applications of differential equations a practical solution of this difficult problem is effected. It may be of interest to follow the solution. If the mean loading on a small piece of pipe is taken as w, then the flexure formula gives

$$EI \frac{d^4z}{dx^4} = w$$

where z is the deflection or radial displacement. The mean load w is the resultant of the internal pressure on the pipe and the component of the circumferential stress q. If E is the modulus of elasticity, m Poisson's ratio, f the longitudinal stress in the shell, and R the radius of the pipe, then

$$q = Ez/R + f/m$$

which after simple reduction gives the differential

equation

$$\frac{d^4z}{dx^4} + 4n^4z = b^2$$

where n and b are constants of the pipe. The effect of the flange is then taken into account, and the resulting expression for displacement is shown to agree very closely with test results. It should be possible to apply the theory as outlined to the study of flanged penstocks, tunnel sections, and the like.

Repeated Bending and Torsion—Experiments on the effect of cyclic or repeated simultaneous bending and torsion are reported. It is interesting to note that when a run of bending cycles was made alone, and then cyclic torsion was added, the maximum strains *decreased;* vice versa, when the torsion cycles were run first and the bending was then added, the deformation also dropped. While the experimenters offer no explanation, it would seem that hysteresis, or lagging behind of the deformation, might account for most of this resulting drop.

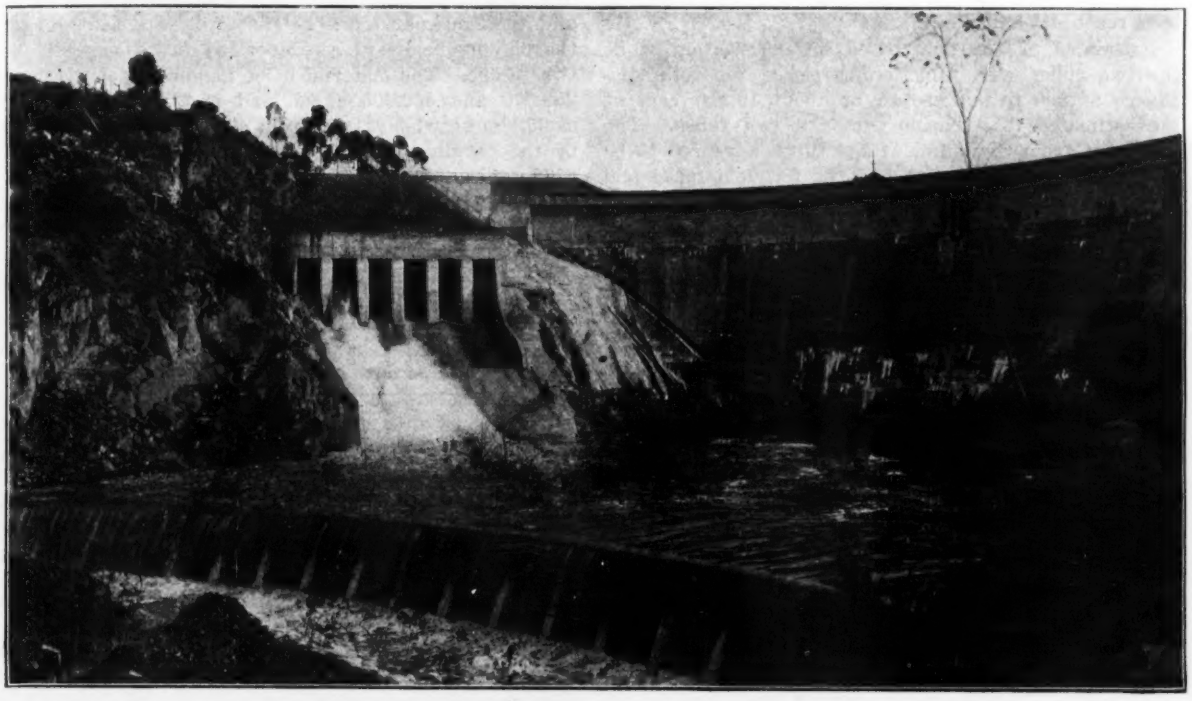
Papers on high-speed discs (turbine discs), stability of rotating shafts with end twist and thrust, and stresses in eccentrically bored pipe, are also included in the report. These investigations contain painstaking mathematical analysis, which, it is gratifying to note, results in workable formulas.

Admittedly, the design of details is the weak element of present-day practice in stress analysis. Such analysis as the present report contains offers hope that the design of details may be improved. Evidently a promising liaison exists between scientific investigators and the engineering profession in Great Britain; one hopes that such co-operation may be encouraged in this country.

Sweetwater Dam Siphon Spillways Function for First Time

One Pair of Tubes Operates Independently, Though Two Adjoining Pairs Are Only 0.1 and 0.2 Ft. Higher, Respectively

SIX SIPHON spillway tubes built in the Sweetwater Dam near San Diego, Cal., at the time of its reconstruction and extension in 1916 had not been required to function up to the first of this year. On Jan. 4, 1922, neglect on the part of the keeper to remove sufficient stop planks from the side-lip spillway on the opposite end of the dam resulted in raising the reservoir level to El. 89.86, whereupon the lowest pair of siphon tubes began to function. This afforded an opportunity to observe the operation of the siphons and the sensitiveness of the automatic control is reported to be gratifying. The siphon spillways were described in *Engineering News-Record*, May 15, 1919, p. 948.



TWO SIPHON TUBES IN OPERATION ON SWEETWATER DAM
The pair discharging are operating at about one-tenth estimated capacity while the adjoining tubes, only 0.1 ft. and 0.2 ft. higher, respectively, remain inactive.

Each of the six tubes has a 6 x 12-ft. rectangular throat section and an estimated maximum discharge capacity of 2,500 to 3,000 sec.-ft. The tubes were built at three different levels for the dual purpose of (1) avoiding the shock incidental to all the tubes starting to function simultaneously and (2) gaining the advantage, if possible, of automatically regulating and limiting the discharge through the siphons in accordance with the rate of inflow into the reservoir. The two tubes nearest the north bank were built with throat levels about 0.3 ft. below reservoir El. 90. The middle pair about 0.2 ft. below and the third pair about 0.1 ft. below the same datum, thus giving a difference of 0.1 ft. in level between successive pairs of the tubes.

The water level in the reservoir early in January reached the level of the lip spillway on the opposite end of the dam from the siphon spillways, and an additional 2 ft. of storage was secured by stop planks placed between piers. When the reservoir level reached the El. 89.86 the lowest pair of siphon spillway tubes began to function. Observation from the upstream side showed that the functioning continued for about 5 to 6 sec. when the suction in both tubes broke. After taking air for about the same interval the siphons again functioned for a like period, this cycle continuing until the reservoir level had lowered to El. 89.62. The same two siphon tubes have functioned twice since Jan. 4, each time the discharge beginning when the reservoir level reached El. 89.86.

Estimates of the flow based on observation while the two tubes were functioning placed the total discharge at 500 to 600 sec.-ft. or about 10 per cent of the estimated total capacity of the two tubes. The discharge from the outlet of the tubes appeared to be about constant in quantity and the frequent make and break of the suction caused an admixture of air and water to the extent that the discharge was described as "an emulsion of air and water."

H. N. Savage, hydraulic engineer for the city of San Diego, under whose direction the reconstruction and extension of the Sweetwater Dam was designed and carried out, supplied the information on which the foregoing is based. In commenting on the operation of the siphons, Mr. Savage said: "Whenever the water in the reservoir attained sufficient height to start the siphonic operation of the tubes, the rate of operation was automatically limited to just the discharge required to prevent the water in the reservoir from attaining a higher level and continued until the level had reduced sufficiently to put the siphons out of commission. On account of the longitudinal cross-section of the siphon tubes and the entrained air it is not surprising that the discharge did not appear to vary materially from a constant quantity, notwithstanding the fact that the intake suction was obviously and prominently intermittent."

St. Gothard Railway Electrically Operated

The St. Gothard Ry. from Lucerne to Chiasso on the Swiss-Italian frontier is now completely electrified, both passenger and freight trains being handled by electric traction. This line is 140 miles long and was opened to traffic forty years ago, since which time steam locomotives have been used. Electrification was begun in 1913 and probably would have been finished by 1916 had it not been for the war. The 62-mile continuation of this line from Lucerne to Basle will be ready for electric traction in 1924 and another line from Lucerne via Zug to Zürich, a distance of 35½ miles, should be electrified by the beginning of next year. The 15,000-volt current generated by three power stations is transformed to 60,000 volts for transmission to substations, of which there are five between Lucerne and Chiasso. Apart from the saving in cost of operation, due to the electrification, the journey by express train between Lucerne and Chiasso has been reduced from five hours to four. It is estimated that the cost of the St. Gothard electrification will amoun' to about 1,000,000 francs per kilometer, or about what the line originally cost to build.

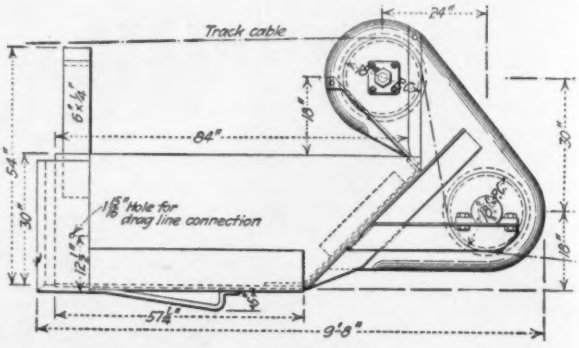
Dragline Excavator Handles Earth On Los Angeles Stadium

Bucket With Two Sheaves Operated on Gravity-Return Plan from 124-Ft. Tower That Moves Along Excavation

By Leroy A. Palmer
San Francisco, Cal.

In the construction of a stadium at Los Angeles, which is being built entirely of earthwork by the cut-and-fill process, all the material is being handled by a dragline excavator operated from a movable tower. The excavation is to have a maximum depth of 31 ft. and the embankment a height of 32 ft., the area of the playing field will be 750 x 344 ft. Slopes will be two to one. The material to be handled totals between 250,000 and 300,000 cu.yd. and is a medium-grained sand almost wholly free from clay and easily handled by the dragline without previous loosening.

The tower has a base area of 30 x 30 ft. and a height of 124 ft. made up of twelve bents. It is built entirely



SIDE ELEVATION OF DRAGLINE BUCKET

of wood, the four corner-posts consisting of 12 x 12-in. timbers with only simple cross-bracing in the plane of each pair of posts. The gross weight with machinery is estimated at 60 to 75 tons. It is arranged to be moved lengthwise of the stadium site on trains of 12-in. wooden rollers, 4 ft. long laid on a runway of 4 x 12-in. plank resting on the earth. Power for moving is supplied by a 30-hp. motor belted to a double drum hoist operating cables to deadmen at the ends of the track.

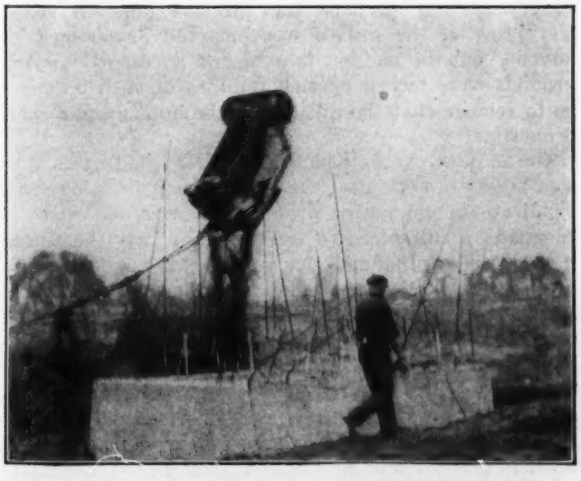
The dragline bucket hangs and operates on a 1-in. track-cable and is drawn toward the tower by a 1¼-in. dragline. As the bucket will return by gravity to any part of the site, no return line is used. The use of double sheaves on the bucket greatly facilitates control from the tower. As shown in the sketch herewith the sheaves are housed at the sides to form guides for the track-cable. The forward sheave is so placed as to prevent the cable from rubbing on the bucket at any time. In loading, the track-cable is tightened slightly to point the nose downward and give the bucket a good bite into the earth as it is pulled forward by the drag cable. With the load well started the brake is released from the track-cable drum, allowing the latter to slack of its own weight as the bucket is drawn toward the tower. On arrival at the desired dumping point the drag-cable is slacked away and the track-cable is tightened. With the tightening of the latter the bucket is pulled clear of the ground and dumped. The brake is

BUCKET IN PROCESS OF LOADING
Tightening the track-cable, which is the only line shown, tilts the nose of the bucket downward, insuring capacity load.

then released from the drag-cable and the bucket runs back along the track-cable by gravity. On reaching the point where the next load is to be taken the track-cable is slacked away so the bucket drops to the ground, the double sheave with its side housing lining the bucket automatically with the track-cable.

The track-cable is operated over a sheave at the top of the tower, the dragline can be operated over either of two sheaves set at 30 and 65 ft. above the ground level, respectively. The control house is in the third bent whence the operator commands a view of the entire work. The power equipment, housed in the base of the tower, consists of a 30 x 60-in. drum carrying the dragline and an 18 x 30-in. drum carrying the track-cable. These drums are so mounted with respect to a 300-hp. motor that the latter can be clutched to either or to both as may be desired.

The far end of the track-line is attached to a dead-man cable stretched the full length of the pit on the opposite side from the tower. It is 750 ft. long with a diameter of 1½ in. At either end this cable is anchored to a 14 x 14-in. timber 20 ft. long, buried 8 ft. in the ground. The track-cable runs over the top-most sheave of the tower which is 460 ft. from the dead-man cable, to a grip which can be moved along the latter and clamped to it at any desired position. The dragline is carried from its drum to the bucket over one of the two lower sheaves, as may be necessary according to the location and height of the point of delivery. In operation the tower is shifted along the side of the excavation as necessary and the far end of the track-cable is moved along the dead man to correspond.



BUCKET DUMPING AS TRACK-LINE IS RAISED
Track and draglines are the only two cables used on this bucket for which speed, economy and accurate control are claimed.

The bucket shown herewith in side elevation is 5 ft. wide and 2½ ft. deep with an average length of 5 ft. This gives a capacity of 2¼ cu.yd. but in actual practice in this material it carries about 50 per cent more than normal capacity, making a load that weighs about 4½ tons. The dot and dash line in the drawing shows the reeve of the cable through the sheaves.

The regular crew of the excavator consists of six men; a lever man, mate, electrician and three laborers. All of these are employed about the tower, none being required in the pit.

The maximum length traversed by the bucket on this job is somewhat less than 460 ft., the distance between tower and dead-man line. The average round trip of the bucket can be made in one minute or less, but averaged over the day's work and for all lengths of haul the trips are found to average about 1⅜ min. each. With the size of bucket used on this job, this gives, in the 288 round trips of an 8-hour day, about 1,000 cu.yd.

The bucket was designed by George E. Fields who is in charge of excavation work on the stadium for the Community Development Association, which is being carried out by the United Dredging Co. of Los Angeles

London to Extend Underground Railways

The Engineer, London, announces the beginning of reconstruction and extension of the London underground railways. The work is divided into three parts: Reconstruction of the City and South London Ry., which was London's pioneer tube; connection between the City and South London Ry. and the Charing Cross, Euston and Hampstead Ry., extending from Euston to Mornington Crescent; and extension of the Hampstead Ry. from Golders Green to Edgware. The first is undertaken principally to enlarge the diameter of the tunnel to permit interchange of traffic with the Hampstead line. It is planned also to lengthen the platforms and rebuild many stations, installing escalators at some of them. During the time portions of the tube are shut down for reconstruction, temporary service will be provided by motor buses. This section to be reconstructed is about 7¼ miles long. The connecting line will be about 1.1 miles in length and will provide at Camden Town for connection with both the line to Golders Green and that to Highgate. For this junction a time table is proposed for a one-minute service in each direction, which will mean 120 trains per hour. The track and signal layout at this point is receiving special study to eliminate grade crossings. It is hoped that the enlargement of the City and South London tunnel and the construction of this connection will be completed in time to open Oct. 1, 1923. The extension from Golders Green to Hendon is 1.63 miles in length and includes two new stations, a viaduct 30 ft. high over the River Brent, retaining walls, and embankments. It is hoped that this work will be completed in fifteen months. From Hendon to Edgware is 3.05 miles. It is expected this line will be complete by 1924.

Protecting Tientsin, China, From Flood Damage

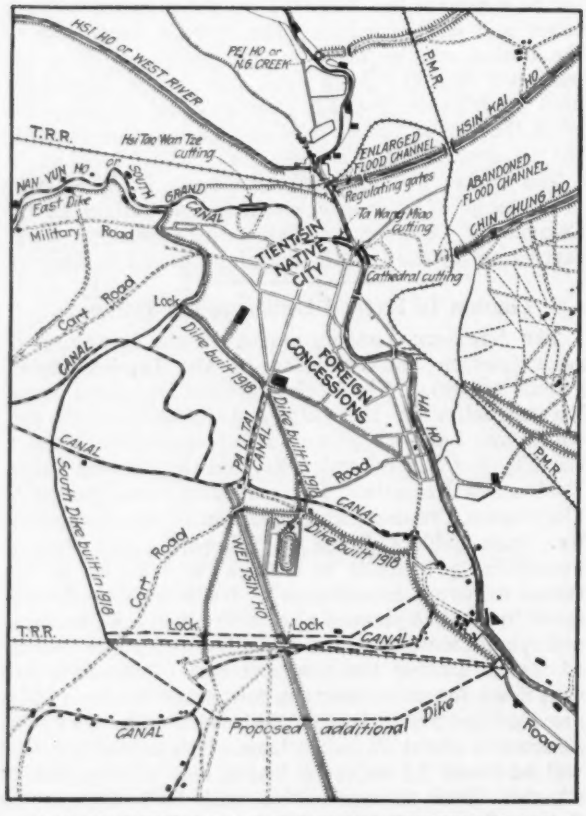
Dikes and Canals, With Regulating Works, Recently Built Indicate Way Modern Engineering Is Developing in China

By R. D. Goodrich

Engineer in Charge of Works, Commission for the Improvement of the River System of Chihli, Tientsin, China.

SINCE the great flood of 1917 in the Province of Chihli, North China, considerable work has been done for the protection of the port of Tientsin from a recurrence of such a disaster as was experienced at that time.

These protective measures have been carried out mainly under the direction of two organizations. The first is the police department of the district of which Tientsin is the seat of local government. The head of this department reports directly to the Civil Governor of the Province. The second organization is the Commission for the Improvement of the River System of Chihli, better known locally as the Chihli River Commission. This commission was formed soon after the 1917 flood, by agreement between the Chinese Government and the diplomatic corps of the foreign countries having representatives in China, for the purpose of planning and executing works for flood protection and river regulation in the province. The Chihli River Commission has co-operated with the civil authorities of the province in several of the works which have been carried out for the immediate protection of Tientsin and has also acted in conjunction with a third organization, the Hai Ho Conservancy. This last named organization is an older one, also formed by diplomatic agreement, but for the improvement and regulation of the Hai Ho, which is the name given to the river connecting Tientsin with the Gulf of Chihli and forming the outlet for the five rivers which unite at this city.

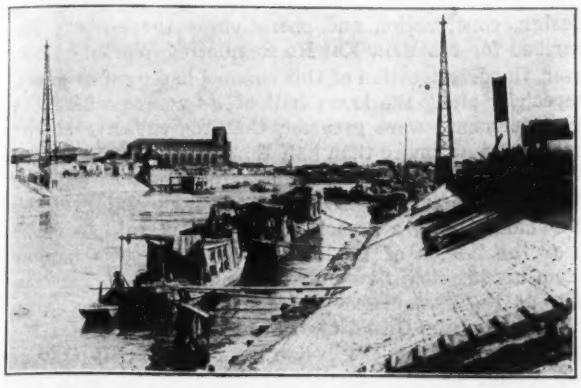


MAP OF TIENTSIN AND ENVIRONS SHOWING FLOOD PROTECTIVE WORKS

The principal flood relief and protection works which have been carried out by these organizations consist of (1) the construction of the South Dike, west and south of the foreign concessions, (2) straightening the Hai Ho and the Nan Yun Ho (South Grand Canal) by making the Cathedral Cutting on the former and two other cuts on the latter, (3) strengthening the main dike for nearly thirty miles along the east side of the Nan Yun Ho, (4) enlarging the Hsin Kai Ho Flood Channel, which was largely silted up through neglect and lack of proper controlling works, (5) replacing the old weir at the head of this flood channel with regulating gates having a lower sill elevation and much greater discharge capacity, (6) the construction of regulating gates at the head of the Ma-chang Canal which is a flood relief channel from the Nan Yun Ho at a point about 70 km. (43 miles) south of Tientsin, (7) the construction of a branch outlet from the Ma-chang Canal, with regulating gates at the head of the branch. The locations of all the improvements near Tientsin are shown on the sketch map.

That part of the south dike built in 1918 was constructed by the police commissioner on the site of the old "mud wall" (which was removed by order of the foreign powers after the Boxer trouble) to a point near the crossing of the Pa Li Tai Canal. For the greater part of the remaining distance, it follows the line of an old highway to the bank of an old loop of the Hai Ho, (Ho is Chinese for River, used mostly in the northern provinces). Most of the material for this dike was taken from privately owned land by police power in view of the emergency, and without waiting for condemnation proceedings or purchase negotiations. As a consequence the height and cross section of the dike is inadequate for permanent protection. This dike cost nearly $90,000 of which about $10,000 was for the removal and reinterment of bodies encountered in the borrow pits. The dike is built through land which has been used for graveyards for perhaps four or five hundred years. Very few of the graves were marked or claimed by anyone, but in one or two places ancestral burying grounds were owned by rich families of such influence as to require that the dike should be built around their properties.

On account of the conditions under which this dike was built an agreement was finally reached whereby a syndicate of interested property owners undertook to construct a suitable dike from a point near the beginning of the original dike to a railway embankment south of the city, while the Commission was to build three so called "locks" of the stop-log type at points where canals crossed the line of the dike and railway embankment. By this plan which was carried out in 1920, together with the purchase of some private lands to secure right-of-way for a part of the original dike, an adequate permanent dike has been built which protects all the foreign and native city concessions which lie south and west of the Hai Ho, from floods like that of 1917. The additional cost of these "locks," the right-of-way for the original dike, together with some repair



CATHEDRAL CUTTING ON THE HAI HO, SHOWING CONCRETE-BLOCK BANK PROTECTION

work and the closing of the old arm of the Grand Canal at the Hsi Tao Wan Tze Cut, has brought the total cost to the Commission for these works to $124,500. All costs are given in local currency or Mex. To obtain an approximate comparative figure in U. S. currency, divide by two. The rate of exchange has fluctuated very widely during the progress of this work. At the present writing this rate is from $205 to $210 Mex. for $100 gold. In addition to the foregoing, the South Dike Syndicate expended about $60,000 in right-of-way and earthwork for about nine kilometers of dike.

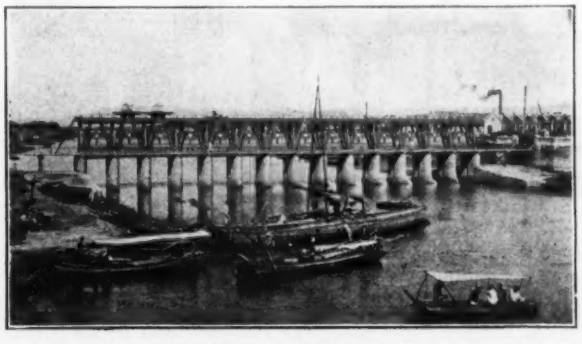
The channel improvements above the foreign concessions were designed by the engineers of the Hai Ho Conservancy, partly to increase the capacity of the river during flood and partly to improve tidal flow during ordinary stages. The work was carried out by a special syndicate co-operating with the police and public works department under authority of the Civil Governor. The Chihli River Commission contributed $70,000 for the two cuts made at the junction of the Nan Yun Ho and the Hai Ho. The syndicate was also partly compensated by being granted title to the abandoned portion of the Nan Yun Ho, which has been largely filled in and is very valuable property in the very heart of the Chinese City. The sale of spoil for filling adjacent low property was another source of revenue.

The Cathedral Cut was first attempted by Li Hung Chang when viceroy of the province, but the opposition of the property owners along the proposed cut was so strong that the plan was abandoned. The right-of-way

BUILDING DIKES FOR NEW OUTLET CHANNEL FOR THE MA-CHANG CANAL

was finally secured and the work done under the supervision of General Yang I Teh, Commissioner of Police and Public Works, doubtless with the aid of the "big stick." The Cathedral Cut involved about 60,000 fongs (257,000 cu.yd.) of excavation and the protection of the side slopes above ordinary low water with precast concrete blocks on a fill of mixed earth and lime (commonly used by Chinese builders for subfoundations) with a system of anchorage to concrete beams back of the slopes. The slope protection for this channel improvement proved to be very expensive so that hard burned brick was substituted for the concrete blocks for the bank protection of the adjacent cut forming the new mouth of the Nan Yun Ho. The extra anchorage was also omitted and the design greatly improved by these modifications. Unfortunately the details of the cost of these improvements are not available.

The Hsi Tao Wan Tze Cut was carried out entirely by the provincial authorities and details of the construction and results are not available. It undoubtedly increases the capacity of the Grand Canal during flood as there are no locks on this portion which is really a river



REGULATING WORKS FOR THE NEW OUTLET CHANNEL FROM THE MA-CHANG CANAL

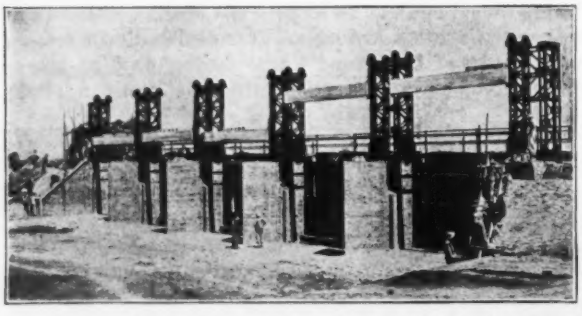
whose course was altered through northern Shantung and eastern Chihli so as to provide for the transportation of tribute rice to Peking.

The following general dimensions of these cuts, taken from reports of the Hai Ho Conservancy Commission, give some idea of the amount of work involved. The Cathedral Cut is 260 ft. wide at ordinary high water level and 145 ft. wide on the bottom with a maximum depth of 21 ft. at O.H.W. The length is about 800 ft. The Ta Wang Miao Cut is 100 ft. wide at O.H.W., 76 ft. wide on the bottom, 6 ft. deep and about 800 ft. long. The Hsi Tao Wan Tze Cut is of the same general section as the Ta Wang Miao and about 1,400 ft. in length.

The strengthening of the east dike of the Nan Yun Ho was one of the most important and valuable protective measures carried out and this was also initiated and carried out entirely by the provincial authorities. The immediate cause of the flood in Tientsin was the series of some sixteen breaches in a distance of about 20 km. (12 miles) from the city. While the former dike was lower and of smaller section than the present one, it could have been made effective but for the natives of the flooded villages on the west side of the canal. In spite of police patrols and the efforts of the villagers east of the canal to save their homes and property from the threatened inundations those on the west side cut the dikes on both sides of the canal to afford additional outlets so as to stop the continued rise of the water com-

ing across the great plain from the west. It is the probable results of the instinct for self preservation which make necessary the additional dikes immediately around the city of Tientsin.

The enlargement of the Hsin Kai Ho involved the removal of about 288,000 fong (1,230,000 cu.yd.) of material from the bed of the old channel about eight miles in length. Below this point additional dikes were built or old dikes raised amounting to nearly 312,300 fong (1,340,000 cu.yd.). The excavation was in two parts, the upper part provided a flood channel at least 100 ft. wide. The second part, or low-water channel, was 8 ft. deeper and 25 ft. wide on the bottom and was located on the center line of the wide channel. The enlarged channel has a capacity in flood of 7,000 sec.-ft. This will provide very material relief so long as unusually high floods do not occur at the same time in



REGULATING WORKS, HSIN KAI HO FLOOD CHANNEL

more than two of the four rivers which unite above this defluent channel. In order to make this channel more effective and provide adequate control, the central portion of the old stone weir was removed and in its place fourteen 10 x 10-ft. sluice gates were erected between 4 x 16-ft. masonry piers. The sills of the gates were placed 10 ft. below the crest of the old weir bringing the tops of the gates level with the old crest. About 30 ft. of the old weir was left at each end to avoid reconstruction of the abutments. The gates are operated in turn by two hand operated hoists carried on a timber trestle 14 ft. high, and can be held open by hooks and chains at the ends of the gates. This structure was designed and built for the Chihli River Commission and the re-excavation of the old channel supervised by the engineering department of the Hai Ho Conservancy.

The total cost of earthwork for improving the Hsin Kai Ho channel was about $160,000 while the reconstruction of the head works cost over $146,000. This work was all completed in 1919 before the flood season. Since this outlet channel is also used to a large extent for transportation purposes, a navigation lock suitable for river craft was built at the head works by the provincial authorities to ensure the usefulness of the canal at all stages of the river.

The native method of constructing sluice gates to control the stages of water in a canal by using stop-logs is quite satisfactory on account of the low first cost, if the openings are to be closed at infrequent intervals as once in a year or once in several years. When more or less continuous regulation is required as at the Hsin Kai Ho and Ma-chang Flood channels more modern types of regulation works are very necessary. At the head of the Ma-chang Canal the old stop-logs were replaced in 1918 by five 14 x 20-ft. gates similar in design, construction and operation to those above described for the Hsin Kai Ho Regulating Works. However, the deterioration of this channel had been so great, especially along the lower half of its course where the encroachments were greatest, that the capacity at the outlet was not more than half that of the upper section. Whenever extremely high water in the Nan Yun Ho made it necessary to divert an extra amount into the Ma-chang Canal, a breach was almost certain to occur near the middle of its length. To avoid this danger from uncontrolled flow over the land south of Tientsin and at the same time provide for greater discharge capacity for the Grand Canal which enters the Hai Ho in the heart of the city below the Hsin Kai Ho Outlet, the Chihli River Commission was charged with the improvement of this second flood relief channel. This has been done by the building of a branch outlet to the south from a point near the middle of the canal where the capacity begins to be materially reduced. This branch is controlled by regulating works consisting of five steel gates 2 m. high by 6 m. in width carried between brick piers 1.8 m. wide by 10 m. long with concrete foundation, floor and apron. The openings are spanned by a highway bridge of reinforced-concrete slab and beam construction with macadam roadway. The gates are counterpoised and provided with individual hoists and structural steel towers to permit of raising them to the level of the bridge. While these head gates and the branch channel have a capacity of only 100 cu.m. per sec. (3,500 sec.-ft.) this is about the capacity of the upper section of the Ma-chang Canal.

The earthwork for the new branch channel amounted to 1,145,500 cu.m. (nearly 1,500,000 cu.yd.) and cost $118,300 or 7.9 c. per cu.yd. The above does not include right-of-way or engineering and supervision. This work was all done by hand labor, being transported from the borrow pits to the dikes in baskets in the usual way in this country. The greater part of the work was done in the fall of 1920 largely by laborers recruited from the nearest famine districts. At one time there were about 4,000 coolies employed. The average rate of work was 1⅓ Chinese fong (5.7 cu.yd.) per man per day. The reason that ordinary earthwork is not done by teams or machinery in China is evident when one remembers that, with the present rates of exchange, the above work was done for less than 4c. per cy.yd. in U. S. currency. About 18 per cent of the excavation was wet and cost about 11½c. Mex. per cu.yd. which brings the cost of the dry excavation to 7c. Mex.

The total cost of the head works for this branch outlet when finally completed will be about $90,000. This work was designed and executed by the engineers of the Chihli River Commission and will serve to illustrate the modern type of permanent structure which the commission proposes to adopt for the more comprehensive plans for river regulation and flood prevention being prepared.

London to Build New Bridge Across Thames

Work is expected to begin shortly on the construction of a new bridge across the Thames at London, to be known as St. Paul's bridge. It will connect Southwark St. on the south side with Cannon St. opposite St. Paul's Cathedral on the north side. The river part will comprise five spans. A roadway width of 80 ft. is projected. Estimates put the cost at £1,650,000. The new crossing is an important relief to the increasingly heavy cross-river traffic.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Shingles and Conflagration Hazard

Sir—We have noticed the editorial in the June 22, issue of your publication, in which you take exception to my statement that the wooden shingle roofs were largely responsible for the spread of the Arverne conflagration. This was true not only at Arverne but at many other places. This assertion is based upon a considerable engineering experience covering conflagrations in a great many different cities, including Atlanta, Augusta, Jacksonville, Fort Worth, Houston, Paris, Hot Springs, Nashville, Salem, Bangor, and elsewhere. There has been no absence of the proof mentioned in your editorial, as far as fire-prevention engineers are concerned. Conflagrations are spread, not only by direct heat striking nearby structures, but also by flying brands, and these brands have, in some cases, ignited wooden shingle roofs as far as half a mile from the original fire, while intervening structures were still intact. In the Atlanta conflagration, embers borne by the wind started such fires in seven different portions of the city. Not long ago at Norfolk, Virginia, burning embers flying through the air started twelve separate roof fires simultaneously, several blocks from the original fire. Photographs taken at Arverne of the more expensive types of dwellings that were burned, show conclusively that the flames traveled from roof to roof.

ROOF TRANSMISSION OF FIRE AT ARVERNE AND EFFECT OF FIRE-RESISTIVE ROOF AT ATLANTA

A copy of one of these views is enclosed, together with one taken in Atlanta, in which a small structure with fire-resistive roof is shown standing unharmed in the midst of the devastated area. We believe that these prints will furnish the proof which you feel has been lacking. Further than this, we might mention the fact that during the five years ended with 1920 our Actuarial Bureau reported losses of $41,667,246 from "Sparks on Roofs" alone, the damage being in addition to that due to conflagrations, which are separately classified.

W. E. MALLALIEU,
General Manager National Board
New York, July 14. of Fire Underwriters.

[There is no difference of opinion about the fact that shingles will burn and the fact that the blast from a fire trends upward and therefore endangers a roof more than a wall. The Arverne picture speaks convincingly on the latter point, and might even suggest, did we not know better, that shingled side walls protect a wooden house from fire. The highest part of the house is the most vulnerable to fire damage, and it is quite logical to make it the first object of fire-prevention treatment. In other words, efforts to reduce the danger of outside fire attack should begin at the roof. But this, we believe, is as far as the argument has been carried successfully. It does not support two claims that have been constantly urged expressly or by implication in the anti-shingle campaign literature: first, the claim that the wooden shingle roof is a great fire menace and in particular is the prime conflagration breeder; second, the implication that the ordinary detached wood-frame-and-sheathing dwelling with wood shingle roof is dangerous. On the conflagration claim, figures giving conflagration losses together with causes would be in order; such statistics as have come to our attention make the shingle appear as a minor factor].—EDITOR.

Land Office and Geodetic Surveys

Public-land survey monuments in the Plains and Rocky Mountain regions are to be connected with triangulation stations, by co-operative field work to be undertaken by the General Land Office and the Coast and Geodetic Survey. Triangulation systems are to be carried from Pecos, Tex., to a point 50 mi. east of Colorado Springs, Colo., and from Pocatello, Ida., to the Canadian boundary, connecting with established triangulation stations. The cadastral engineer will identify the land-survey points and will co-operate with the geodetic engineer in making connection to the stations of the triangulation survey. The corners located will be reconstructed as permanent monuments according to the standard specifications approved by the Board of Surveys and Maps. The Coast and Geodetic Survey will determine the latitude and longitude of the points of reference. A degree of accuracy corresponding to that of secondary triangulation will be provided for. Preliminary results will be available shortly after the close of the present season.

NEWS OF THE WEEK

New York, August 3, 1922

Power Commission Sticks to Depreciation Ruling

In Answer To Petitions Decides That Amendment of Basic Act Is Only Way To Reform

The Federal Power Commission has decided that it has not the authority to alter its present depreciation regulation because that regulation is in accordance with the water-power act. It has informed the representatives of the electrical industry who have been petitioning for a more favorable depreciation regulation that their only relief is in legislation amending the act.

As a result of the dissatisfaction with the depreciation regulation, the commission ordered a careful study made of the act, of similar state statutes and of decisions of state courts and commissions which had a bearing on the matter in question. Both the National Electric Light Association and the National Association of Railway and Utilities Commissioners submitted briefs which were considered in connection with the whole subject matter by the chief counsel of the commission and by the law officers of the Departments of War, Interior and Agriculture.

Analysis of Decision

These law officers agree that in view of the use of the word "depreciation" in the federal statutes, and as defined in decisions of federal courts and of federal and state commissions, the primary purpose of accounting for depreciation under the Federal Water-power Act is that reserves may be established and maintained sufficient for offsetting the reduction in service value, due to accruing depreciation from whatever cause and for maintaining the original investment, unimpaired and adequate for renewing and replacing, so far as respects their original costs, units of equipment or structures when their useful lives expire. The chief counsel of the commission holds, and the law officers of the three departments agree with him, that the act, as now worded, requires an accounting for depreciation substantially as set forth in the existing regulations. It also is held that the definition of "depreciation" as proposed by the representatives of the National Electric Light Association and the amendment of the regulation proposed by them with respect to accounting for depreciation are not in conformity with the act.

O. C. Merrill, the executive secretary of the commission, told the commissioners that he is not convinced that the provisions of the act with respect to depreciation are in conformity with the wisest public policy, or that they are in the best interests of the rate payers, in the long run. He expressed the belief that the questions should be approached primarily from that standpoint. He suggested to the commission that, if upon further consideration, it should appear unwise to require the fully accrued depreciation to be taken up on the licensee's accounts, steps should be taken to secure an amendment of the act.

Mr. Merrill suggested and the commission approved that it should be optional with licensees whether they account for depreciation on the straight-line or on the sinking fund basis until the act be amended. A further suggestion by Mr. Merrill, also was approved by the commission that he be authorized to confer with the Water-power Development Committee of the National Electric Light Association, and others interested, with the view of presenting to the commission proposals for such a degree of flexibility in the annual charges of accruing depreciation as will give due consideration to the maintenance, both of the financial credit and of the capital assets of the licensee.

Omaha To Have Rapid Filters of 50-M.G.D. Capacity

The Metropolitan Utilities District of Omaha has begun construction of a 50-m.g.d. filter plant. The design will follow closely that of the Chain of Rocks plant at St. Louis with the exception of the collecting system, which will be a combination of concrete conduits and perforated pipes. The plant is so designed that it can readily be extended to a 100-m.g.d. capacity. Fortunately for the city, says F. P. Larmon, chief engineer, it will be able to utilize its present sedimentation basins for coagulation and for storage of the filtered water. All work will be done within the organization.

Propose Kern Water District

By the proposed organization of the Kern River water-storage district in California, embracing 260,000 acres to be irrigated by river water and pumping plant, a 300,000 acre-ft. capacity reservoir would be created in Hot Springs Valley. It is estimated that the district would cost from $15,000,000 to $25,000,000.

At the hearing held in Bakersfield, Cal., recently, before W. F. McClure, state engineer, which was conducted in behalf of the protestants to the proposed district, there occurred conflicting testimony as to the water level maintained in the McFarland district. In order to establish the facts in the case the hearing was adjourned until the state engineering department shall make an investigation of this and other features.

Public procedure will be resumed in Bakersfield Aug. 29. When the case is reopened, however, it will be in the nature of a new proceeding, as the state law provides that water-district hearings cannot be continued in excess of two weeks after the time of opening the hearing.

Buckling of Airship Keel Blamed for "Roma" Disaster

Summaries of reports of experts on the destruction of the semi-rigid dirigible "Roma," of the War Department on Feb. 21 have just been made public by Secretary of War Weeks. A report was made by the Chief of Air Service with the aid of a number of outside experts, and upon submission of this report to the air attaché of the Italian Embassy a separate report was made by him on the part of the Italian designers and builders. The reports diverge in their conclusions.

On Feb. 21 the "Roma" dived to the ground at Norfolk, Va., while flying at 50 to 60 mi. per hr. about 600 ft. above ground, and took fire and burned. Of those on board only 11 persons survived, while 34 were killed. Partly because of this fact the conditions and causes of the accident could not be determined with certainty. The Air Service concludes it to be most probable, however, that a slight flattening of the top of the nose and partial failure of the nose cap resulted in a downward pressure on the nose tending to produce a dive; that the stabilizer planes at the tail, tending to correct this action, brought a heavy strain upon the keel; that the keel yielded slightly near the rear end, and thereby placed the stabilizer surfaces into a position where they no longer acted effectively; and that the absence of provision in the pilot house for stopping the engines instantly was responsible for the forward pair of motors (there were six Liberty motors in all) continuing to run at normal speed until the vessel hit the ground.

Disagreeing with the theory of yielding of the keel, the Italian explanation points out that the stabilizer reaction due to pressure on the flattened nose could not be great enough to overstress the keel, and that the greatest stresses in the keel occur at the mid-section rather than near the rear end. It finds as most probable cause a failure of the elevator-rudder controls, due to breaking of the rudder cords provided to hold this rudder in horizontal position, followed by breaking of either the steering cable of this rudder or some other part of the control mechanism under the sudden strain. When uncontrolled, the elevator rudder had a tendency to drop at the rear to an equilibrium position about 8 deg. from horizontal, and through such change of angle the airship was caused to dive.

Mears to Retain Commission

To meet a decision of the Comptroller General that his service as a member and chairman of the Alaskan Engineering Commission, a civil function, deprives him of his army commission, the House has passed a resolution authorizing the appointment of Frederick Mears as an officer of the army and making him eligible to continue the engineering commission office.

Action by F. A. E. S. Committee on Procedure

The Committee on Procedure of the Federated American Engraving Societies, of which Calvert Townley is chairman, held a meeting on July 14 at which the following action was taken:

"The invitation to send representatives to the Pan Pacific Commercial Conference in September was accepted. Appointment of a representative to attend the Engineering Congress in Rio de Janeiro in September was authorized. The president was also authorized to co-operate with the necessary authorities in appointing a committee of engineers to make a trip to China to form personal contacts and encourage friendly relations.

"The return of patents from the Chemical Foundation to the Alien Property Custodian was considered by the committee following which a resolution was addressed to President Harding requesting that action be delayed until representatives of the chemists, chemical engineers and manufacturers, and others could be heard. It furthermore implored that nothing be done which would in any way tend toward the ultimate return, to former owners, of patents and other property lawfully sequestered and sold to Americans.

"Revision of the mining laws proposed in H. R. 7736 was approved by the committee and council directed to use its influence in furthering the passage of the bill subject to committee amendments. The executive secretary is in communication with the chairman of the mines and mining committee on behalf of this legislation.

"The committee approved the opinion that the following bills were not within the scope covered by the activities of the American Engineering Council; The Bacharach bill affecting public utilities companies, the Merchant Marine bill, the Trade Associations Regulating bill and the Ship Subsidy bill. It approved the principle of the hydraulic laboratory bill but recommended that no special exertion be made in favor of it until a special committee of the Boston Society of Civil Engineers, to be appointed at the request of Council, could review the subject and advise the Executive Board."

In connection with the above action on the chemical patents, Dean M. E. Cooley, president of the F. A. E. S., makes the further announcement: "It is of importance to note that the Federated American Engineering Societies speaks concerning national problems for thirty odd national, state and local engineering societies. The federation, therefore, speaks on behalf of some 55,000 engineers."

Philadelphia Sells Bonds

A $6,000,000 issue of 4 per cent, 20-50 year improvement bonds, redeemable at 103 on 30 days' notice, has been sold at 3.93 + by the City of Philadelphia. This was the most favorable yield rate among 16 issues totalling nearly $15,000,000 reported by the New York *Times* for the week ended July 28. All but 3 of the 16 sales were at a yield rate of less than 5 per cent, one being at 5, one at 5.10 and one at 5.50.

Road Builders Give Views on Priority Order

Delay to Work Seen in Reducing Supply of Railway Cars for Highway Materials

IN answer to a telegraphic request for their views on the probable effect of railway car priority orders from the Interstate Commerce Commission on the road building program, state highway officials have sent *Engineering News-Record* the following replies:

Texas—On 90 per cent of our highway projects under construction crushed stone, gravel and sand are shipped in by rail and the same will apply on 800 miles of new highway work to be let in the near future. The shipping of such materials only upon priority orders issued by the Interstate Commerce Commission will greatly retard delivery of necessary road-building materials and will undoubtedly increase the cost of highway work as well as retard completion of work under contract. —*J. D. Fauntleroy, state highway engineer.*

Washington—Commerce Commission priority orders will not seriously affect our road-building program. Much of the aggregate for paving and bridges is produced from pits located within truck haul of the jobs. Contractors have stocked ahead with cement. Some of the contracts are served by water transportation. Railroads feel confident they can keep contracts going.—*James Allen, state supervisor of highways.*

California—So far as I am aware, the Interstate Commerce Commission priority order concerning railroad freight movements is limited to states east of the Mississippi River. Were this order to apply west of the Mississippi River chaos would be the result so far as our road-building operations are concerned, since we have several million dollars' worth of work under contract and are at the height of our road activities. The condition must be extremely embarrassing in the Eastern states which are in a like condition, and it appears to me to be extremely stupid to promulgate such an order without giving adequate consideration to the road-building program of the country.—*A. B. Fletcher, state highway engineer.*

Indiana—Commerce Commission priority order shows no noticeable effect to date.—*C. Gray, chief engineer, state highway commission.*

Kansas—Priority orders of Interstate Commerce Commission, if enforced in this state, will place all road projects of concrete, brick, and bituminous macadam at standstill. Practically all this work involves rail shipments, and shortage of aggregate will result in shutting down a contract, as none of the contractors has been able to store sufficient material in advance.—*M. W. Watson, state highway engineer.*

Maryland — Commerce Commission priority order has not affected road building program because sufficient material was in transit when issued to keep work moving. However, all material people are declining further shipments because of this order and within a week we expect an entire cessation of road building work in this state.—*J. N. Mackall, chief engineer, state roads commission.*

New York—If the conditions anticipated by the Interstate Commerce Commission's priority order should develop to the extent that it is necessary to enforce it strictly, it will of necessity seriously interfere with our road-construction work. A modification of this order permitting the use of open top cars for the loading of road-building materials when the point to which these shipments are destined is in the general direction of the empty return movement to the mines would be of material assistance. — *Fred W. Sarr, first deputy commissioner of highways.*

Virginia—Priority orders issued by the Interstate Commerce Commission giving preference to the handling of fuel, food products and live-stock up to date have not greatly interfered with our road building in this state. At one

Coal Shortage Threatens Shutdown of Cement Mills

The effect of the coal shortage on industrial operations, already noticeable in reports from New York stating that some of the large steel mills will probably have to shut down unless the coal strike is settled within the next few weeks, is also being felt by the cement industry and the difficulty of obtaining coal has caused a number of plants to cease operations for the time being. A statement issued by the Portland Cement Association in Chicago points out that the cement industry is the fourth largest consumer of coal in the country, over 7,000,000 tons being consumed at cement mills every year. Many of the mills have been having difficulty in securing coal for some time. With the regular source of supply shut off by the strike the mills have been forced to secure coal from more distant mines, at higher prices and a longer haul. As many of these sources are now cut off the situation has become acute and unless the strike adjusts itself in a few weeks more of the plants will be closed, or operated on part time.

Coming at a time when the country is experiencing one of the greatest building booms in its history, a shortage of cement would have a serious effect on every class of construction operation. As cement enters into practically every building that is erected the cutting off of the cement supply through the coal strike would tie up many of the building projects. A similar effect would be felt by the road construction industry.

In addition to the coal strike, the railroad strike has a direct effect on the cement supply. The equivalent of 377,000 box cars of 50-ton capacity each were required to haul last year's cement output to the consumer, and if the strike ties up transportation it will be impossible to get the cement shipped to the points where it is needed.

or two points our work has been somewhat delayed, but nothing of a serious nature has developed and we are hoping that the situation will improve rather than get worse.—*H. G. Shirley, chairman, state highway commission.*

Pennsylvania—On receipt of advice from Washington on the issuance of Service Order No. 23 of the Interstate Commerce Commission, this department immediately outlined a program of procedure similar to that used during 1920. We are in touch with all contractors and are now receiving statements from them covering their material requirements daily, and are preparing full data so that, if steps can be taken to remedy the situation, we will have the necessary data to reinforce our requests. It is too early to give a reasonable prediction as to the effect of the order. While we are hopeful that the situation will not be as difficult as in 1920, still the strike situation, particularly as it affects the coal fields of Pennsylvania, would seem to point to a very marked decrease in the number of available hopper-bottom cars on the resumption of coal production. Therefore, we are not overly optimistic, particularly as to shipments after Aug. 25. We are recommending to all contractors the stocking and storing of materials to their maximum capacity *now.*—*W. D. Uhler, chief engineer, state highway department.*

Massachusetts—I do not know exactly what priority orders may be contemplated, but assume that they will refer only to coal. From what I can learn by interviews with New England railroad officials, such priority orders would have little effect on our road-building program as there is apparently not sufficient coal to be shipped to interfere seriously with the shipment of other materials.—*A. W. Dean, chief engineer, state highway department.*

Oregon—Coal strike priority order of Interstate Commerce Commission will not affect Oregon road work, according to highway officials of that state, as sand and rock from local sources are used almost exclusively. However, should the railroad strike situation reduce the supply of covered cars, that would materially interfere with proposed work by delaying cement and asphalt deliveries.—*State highway commission.*

New Jersey—We have no definite information as to the exact context of the priority orders, so that it is difficult to know the extent of them. We have, however, tried to anticipate the issuance of such orders and have telegraphed previously to all contractors doing work in this State, advising them to increase their stock of road materials so that their work would not be held up because of orders which might be issued in the future by the Interstate Commerce Commission. We feel that this has helped to some extent. Another great advantage to the contractors in New Jersey in this connection is the fact that our specifications provide that contractors may be paid not to exceed 80 per cent of the value of materials on the ground but not in place, and this is a decided advantage to the contractors in the condition which we are confronting at the present time.—*T. J. Wasser, state highway engineer.*

FOR NATIONAL ENGINEERING MUSEUM AT WASHINGTON

A committee of the American Society of Mechanical Engineers, originally appointed to co-operate in the collection of historical material bearing on the work of Cornelius H. DeLamater and Capt. John Ericsson, has started a movement to establish an engineering museum in connection with the National Museum at Washington. The plan has the support of the Smithsonian Institution. The committee invites requests for further information from engineering societies and alumni associations of engineering schools that may be interested, which should be addressed to Joint Committee on the National Engineering Museum, Engineering Societies Building, 29 West 39th St., New York City.

Report on New York Subway Fire Exonerates Pyrene

Report has been made by the New York Transit Commission of its investigation of the fire that precipitated a near-panic on a Lexington Ave. subway train on July 6. (See *Engineering News-Record*, July 13, 1922, p. 80). The commission has found that the fire was caused by a short-circuit on a panel board in the vestibule of one of the cars and that the smoke and fumes liberated were from burning insulation, rubber, paint and varnish. There were no fatalities and those that were overcome were affected by the smoke from the burning insulation and by the haste with which they climbed the 75 ft. to the surface.

Immediately after the fire many statements were made indicating that passengers had been overcome by fumes generated by the use of Pyrene extinguishers, and pending the investigation their use had been restricted by the subway management. The inquiry reveals no ground for these statements, and the investigators recommend resumption of the use of the Pyrene to extinguish electric-arc fires.

Hearings on Need for Hydraulic Laboratory Soon to Begin

The Senate Committee on Commerce has authorized a thorough investigation into the advisability of establishing in Washington a national hydraulic laboratory. This action is taken because members of the committee are unanimously of the opinion that insufficient attention has been given to the scientific side of flood control. A sub-committee was appointed to hold hearings and to conduct the investigation. Senator Ransdell, of Louisiana, was chosen to head the sub-committee; Senator Dupont, of Delaware, and Senator McNary, of Oregon, are the other members. The Secretaries of War, Interior and Commerce have been requested by the sub-committee to report as to the need for such a laboratory and as to their opinions upon its value.

The initial witness probably will be John R. Freemen, president of the Am. Soc. C. E., at whose suggestion this legislation was initiated.

Two Brooklyn Bridge Cables Shift on Saddles

City Commissioner Recommends New East River Bridge and Rebuilding Old

Two of the four main cables of the Brooklyn Bridge across the East River at New York slipped in their saddles recently, according to Edward A. Byrne, chief engineer of the Department of Plant and Structures, New York City. The information was given in connection with a request by Commissioner Whalen of the department, to the Board of Estimate and Apportionment, for authorization to build a new bridge near the Brooklyn Bridge, as a preliminary to the rebuilding of the present structure. An additional bridge is needed by the steadily increasing traffic, and it is not possible to modernize or increase the traffic capacity of the Brooklyn Bridge before a new structure is ready to take its traffic during the reconstruction.

The cable movement, which was noticed on June 15, affected the two north cables at their west or Manhattan tower support. The north or A cable moved 1¾ in. in the direction from the shore span to the main span, and the next or B cable moved ¾ in. in the same direction.

No other change of condition in the bridge has been discovered in the regular inspections or in special examinations carried out since the movement was noticed. In particular Mr. Byrne states that the anchorages and towers show no change in any respect and are in excellent condition, and that the suspended structure also is normal.

The cable movement is regarded as a readjustment of strains probably connected with a similar movement in 1898, when trolley cars began operating over the bridge. The southerly cables showed the most movement at that time, while the north cable had little or no movement. That motion was a slipping of the cable saddles on their supports, the rollers having been rusted fast during the preceding years. Since that time the saddles have been blocked. The present movement was a slipping of the cables in the saddles.

Hoover Heads Commission to Direct Distribution

Secretary Hoover has been appointed by President Harding to be chairman of the governmental commission that will direct distribution of the available supplies of coal and other necessities during the current railroad and coal strikes. The power vested in this commission is to be exercised subject to the needs of the emergency. Priority in transportation will be given to essentials in the following order: Food, feed for live-stock, live-stock, perishables, coal, coke, and fuel oil. In the movement of coal preference is to be given to transportation agencies, public utilities, ice and refrigerator plants, hospitals and other public institutions.

The secretary has asked the co-operation of the state authorities and commissions in carrying out plans for regulation and will make every effort to handle the situation through local agencies.

Start Last Traffic Run on Bates Test Road

Chief Engineer Older Comments on Indications of Results Thus Far Secured

The $300,000 Bates experimental road sections near Springfield, Ill., are now being traversed by the last and heaviest loading originally planned, 8,000 lb. per rear wheel. Many parties have visited the road at the invitation of the Illinois State Highway Department but the largest delegation so far comprised 60 members of the Detroit Automobile Club, state and county highway officials of Michigan and Wisconsin, who made an inspection, July 24.

Clifford Older, chief engineer, in explaining the results (which will be summarized in *Engineering News-Record* next week) indicated that with the laboratory tests corollary with the road tests rational designs could now be made with definite predetermined factors of safety. In general the findings, he said, are as follows:

Fatigue tests on 6-in. cantilever beams of concrete indicate that several million applications can be made if the load is less than 50 per cent of its amount at the point of rupture. When the load is increased 10 per cent breakages occur with a few thousand applications.

The result on pavements of impact from a drop of about ⅛-in. is less than the result of static loads. Curling of the edges at night, due to temperature changes, is nearly ¼-in., and has been proved beyond a doubt. The night breaks under traffic at edges have been three times as frequent as the day breaks. In consequence, the design for corners, the weakest place, is the critical feature. Practically all failures have started from corner breaks. It is significant that no early breaks have occurred on the north side of the road where the drivers keep the outside wheel about 3 ft. from the edge; all breaks have occurred on the south side where wheel loads are at the edge.

Subgrade Observations

Subgrade observations indicate continuous moisture content which is not affected by drains. Mr. Older was particular to point out that this referred to the brown loam of Illinois in which capillary attraction was strong and held about 25 per cent of moisture throughout the summer, with rises in spring and fall to 40 per cent. He concluded that money for drains in this type of soil is thrown away.

The 5-in. slabs are beginning to break up under the 8,000-lb. wheel loads after about 2,000 trips. This loading is the maximum permitted by the Illinois state law. For the earlier loadings 3,000 trips were made for each increment of increase, but for the last loading it is planned to continue the test until 10,000 trips have been made. It is unlikely that this will have any effect on the 8- and 9-in. sections. If it is decided to break these heavier slabs, heavier trucks will have to be provided as the sixteen units now in use carry a 1-ton overload.

Expressions of opinion indicated that many views held by the visitors were being abandoned. The questionable value of drainage and use of broken stone under pavements were particularly debated. On the other hand the Wisconsin and Michigan engineers expressed a feeling of satisfaction that their present designs were adequate. From those who were looking for the big result one thought seemed predominent, viz., that in some way truck makers and road designers were going to be able to get down to a definite basis of design, the truck to be reasonably limited and the road to care for that limit. Mr. Older feels that ultimately zones will be prescribed with 8- or 10-in. slabs built in and around large centers and perhaps as thin as 4-in. slabs provided in strictly rural territory.

The Engineer in Public Life

M. T. CALEF

M. T. Calef was elected to the state legislature of Indiana in 1920. He introduced the Engineers' Registration Law in the 72nd Indiana General Assembly of 1921; was author of two road bills and member of the following committees: Roads, county and township business; manufacturing and commerce; claims; and public bills and swamp lands.

He was born in River Sioux, Iowa, 34 years ago, on a farm of which he tired, going west in 1906, to Baker, Ore., where he became interested in hydro-electric work, from camp cook to lineman. He worked his way through Oregon State College and was graduated in 1911 with the degree of B.S. The next two years were spent with the Warren Construction Co. of Portland, Ore.

From 1913 to 1916 Mr. Calef attended the postgraduate school of highway engineering at Columbia University, taking the degree of Master of Engineering. He then became road engineer for the Rocmac interests of Philadelphia and Toronto. In 1916 he went to the State of Washington where he engaged in paving and road construction. That same year he moved to South Bend, Ind., where he was district sales engineer for the France Stone & Slag Co. of Toledo until 1921. He then organized the Highways Improvement Co. of which he is president and treasurer.

Mr. Calef is a charter member and first president of the St. Joseph Valley Chapter of the American Association of Engineers. He is a member of the South Bend Chamber of Commerce and is the inventor of several forms of road-construction machinery.

Trade Commission Member Sworn In

On June 30 Judge Vernon W. Van Fleet, former judge of the Superior Court at South Bend, Ind., was sworn in as a member of the Federal Trade Commission.

Announces Narrows Tunnel Staff

The chief engineer of the Board of Estimate and Apportionment, of New York City, announces the appointment of the staff that will prepare plans for the Brooklyn-Richmond freight and passenger tunnel, generally known as the narrows tunnel. The more important positions provided for are:

Administrative: Arthur S. Tuttle, chief engineer and Herman H. Smith, deputy chief engineer; D. W. Coe, resident engineer; William J. Shea, and Francis H. Phipps, assistant engineers; Leon K. Merrill, auditor; and William M. Conant, statistician.

Consultants: Glen E. Balch, on dredging; Wilson S. Kinnear, on railroad and trench tunnel design and construction; Frederick C. Noble, on tunnel design and construction; Henry B. Seaman, on structural design; John F. Sullivan, on project; and Silas H. Woodard, on tunnel design and construction.

Design and construction staff: Jesse B. Snow, tunnel engineer; Charles D. Drew, principal assistant engineer; William McK. Griffin, resident engineer; Clarence K. Conard, railroad engineer; W. C. Lancaster, electrical engineer; John H. Quimby, designing engineer; Robert C. Strachan, Charles J. McGronan, Melvin D. Casler and Edward M. Law, assistant engineers.

Plan Large Road-Contract Lettings in Missouri

Several million dollars' worth of highway contracts, it is expected, will be let in Missouri before the first of the year as the result of the designation of a 1,500-mile system of primary state roads in a report just submitted to the state highway commission by Rollen J. Windrow, consulting engineer and assistant to the chairman, and B. H. Piepmeier, chief engineer. Missouri has already voted $60,000,000 of bonds to be used in the construction of 76,000 miles of state roads. The law provides for the selection by the commission of 1,500 miles of this system to be classified as primary or trunk-line routes. The commission has planned to hold a public hearing this week to consider the recommendations of its engineers and will then reach a final decision regarding the issuance of $10,000,000 at once to enable work to be started.

The state highway department has plans prepared for a large mileage of the recommended system and everything is in readiness for letting contracts as soon as money is available from the sale of the bonds. The 1,500-mile system was selected to connect the principal centers of population and not primarily to form connection with adjoining states. The system connects 26 cities containing 1,453,891 people.

Cresson to Study Foreign Ports

B. F. Cresson, Jr., chief engineer of the Port of New York Authority, has sailed for Europe, where he will inspect the principal ports. He plans to visit Liverpool, Manchester, Glasgow, London, Southampton, Copenhagen, Stockholm, and possibly the German ports; and will study particularly the operation and management of the Port of London under the Port of London Authority.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The American Association of Engineers at a recent meeting of the Board of Directors, appointed the following committee chairmen: Qualifications, R. C. Kellogg; practice, E. E. Carpenter; services and fees of practicing engineers, L. E. Ayres; salaries of engineers in teaching service, C. J. Tilden; engineering education and classification of engineering schools, Frederic Bass; classification of engineering positions, A. B. McDaniel; chapter activities, J. P. Kelly; publications, A. N. Johnson; political policies, Raymond Burnham; auditing, C. A. Hoglund; legislative, W. W. DeBerard; salaries of engineers in public service, S. C. Hadden; railroad advisory, W. C. Bolin; amplification of ideals and objects, F. H. Newell.

The Connecticut Society of Civil Engineers held its annual outing at the Connecticut Agriculture College, Storrs, Conn., July 25. Besides an elaborate sports programme there were several short addresses including one by President Beach of the College on "What the College is Doing for Connecticut."

Personal Notes

FRANK RYNEARSON has been elected as road supervisor for the borough of DuBoistown. He has served as a road supervisor throughout central Pennsylvania for twenty years.

C. R. HORNE, resident bridge engineer on the Choctawhatchee River Bridge, has severed his connection with the Florida State Road Department and has accepted a position with the U. S. Bureau of Public Roads.

H. D. BARNES, F. S. PICKERING and L. F. GOFF have recently been appointed by the Kansas State Highway Commission as county engineers of Butler, Johnson and Rawlins Counties, respectively.

FRANK A. RUSSELL has been elected professor of engineering at the University of Kansas, to succeed Prof. C. C. Williams who recently resigned to become professor of civil engineering at the University of Illinois.

CHARLES D. CAMPBELL, of Hamilton, Ont., has been appointed city engineer of Belleville, Ont. He succeeds JOHN L. MILL. He was formerly resident engineer of the Galt, Hespeler & Preston R.R.

ARTHUR H. BICKERSTAPH has recently opened an office in Titusville, Pa., for the practice of surveying and mapping.

JAMES AUSTIN MORTLAND, who recently resigned as bridge engineer to the Florida State Road Department, has opened a consulting engineering office in Tampa, Fla.

W. S. EARLE, division engineer for Florida State Road Department, has resigned to take charge of the construction of roads for Seminole County.

W. H. STEINER has been appointed district engineer in charge of the Des Moines office of the Portland Cement Association to succeed H. L. TILLSON, resigned. Mr. Steiner has been connected with the Association for the past three years, most of that time having been spent in Iowa. He was also city engineer of Marshalltown, Iowa, for ten years.

L. L. FIELDER, general foreman for the Willite Road Construction Co., Sparta, Mich., has been made superintendent of road construction.

JOHN A. CONNELL, former resident engineer with Lockwood Greene & Co., Boston, Mass., has become associated with Tooker & Marsh, New York City, architects and engineers as superintendent of construction.

FRANK A. DANFORTH, topographic engineer with the U. S. Geological Survey, has returned from a two-year assignment in the Hawaiian Islands and has been assigned to work in the vicinity of Frankfort, Ky.

GEORGE CALDER has been made resident engineer for the city of Sacramento, Cal., on the uncompleted part of the filtration project for which work bids are to be received August 24. Mr. Calder succeeds C. G. Gillespie. He has been connected with the filtration project since its construction, having been in charge of making plans for the remainder of the project.

PROF. FREDERICK K. MORRIS has resigned as professor of geology at Pei Yang University, China, to act as an assistant to DR. C. P. BERKEY, who is chief geologist of the Third Asiatic Expedition under Dr. Roy Chapman Andrews. Dr. Berkey has been professor of geology of the University of Columbia for thirteen years, but is now on leave of absence.

J. H. KIDD of Kingsport, Tenn., has been elected city engineer of Knoxville. He assumed his new duties August 1.

CHARLES C. SMITH has severed his connection with the general contracting firm of Scarborough, Smith & Davis, San Angelo, Texas, and is now a partner in the contracting firm of O'Connor & Smith.

E. A. WOHLFORD, formerly associated with Mees & Mees, consulting engineers, Charlotte, N. C., specializing in water-power development, has joined the Thies-Smith Realty Co. of that city. Mr. Wohlford is engaged in sales work as well as in estimating and general engineering practice.

Obituary

GERARDUS HARRISON, who was with the consulting engineering firm of H. and C. J. Goldmark, New York City, died July 24, aged 34 years. He was graduated from Cornell University in 1910, since which time he had been actively engaged in the practice of engineering. During the war he was in charge of important government construction work at the plant of the Lima Locomotive Works at Lima, Ohio. Other important work with which he was connected included the erection of the two foundries of the Canadian Locomotive Works at Kingston, Ont. He was an associate member of the American Society of Civil Engineers.

EDWARD N. RALEIGH, principal assistant engineer of the Department of Public Works, Borough of Manhattan, New York, died July 16, aged 42 years. He was connected with this department for some twenty years. His early work was in connection with the Riverside Drive Improvement north of the Manhattanville Valley. In later years he had general charge under the chief engineer of the designing, construction and maintenance of the sewers, pavements, viaducts and all other public works under the borough president's jurisdiction.

WILLIAM A. THOMPSON, vice-president of the Texas Co., New York, died in that city July 24, aged 48 years. Mr. Thompson was in charge of the export department, northern territory sales, and asphalt sales, and as president of the Texas Steamship Co. was well known as a shipping man. Early in his business career he became interested in shipbuilding in Duluth, and later on the Mississippi. Besides being a director and member of several corporations he was a member of several New York clubs, the Engineers Club being among them.

Business Notes

MAURICE L. MILLER, engineers, is the name of a consulting hydraulic and sanitary engineering firm, recently organized in Denver, Colo.

EDWARD C. DILWORTH has opened a consulting engineering office at 302 Walsh Building, Pittsburgh, Pa. He will pay particular attention to industrial building, retaining walls, bridges, reinforced concrete work and foundation work.

E. R. WIGGINS, formerly with the Chilton Co., Philadelphia, as technical editor of the *Chilton Tractor Journal*, has joined the sales department of the Holt Mfg. Co., Peoria, Ill. He will do special work as a sales engineer. Mr.

Wiggins, in addition to his work with the Chilton Co., has been connected with the J. I. Case Threshing Machine Co., Racine, Wis.; The Aultman & Taylor Machinery Co., Mansfield, Ohio, and Deere & Co., Moline, Ill., doing engineering experimental work in tractor development.

J. A. ROSS and J. E. BELLOWS, formerly with the S. A. Woods Machinery Co., have formed a partnership for handling corrugated cutter and knife equipment under the firm name of Ross Cutter & Machine Co., Dorchester, Mass.

JAMES A. BEAUBIEN, formerly vice-president and general manager of the Weber Subterranean Pump Co., has become manager of the New York office of the Pennsylvania Pump & Compressor Co., Easton, Pa.

EQUIPMENT AND MATERIALS

Asphalt Surface Heater

The Hauk Manufacturing Co., Brooklyn, N. Y., has put on the market an asphalt surface heater and patcher which uses kerosene as a fuel. The heater is made in two sizes with tank capacities of 25 and 50 gal. and with two and three burners; the weights are, respectively, 460 and 860 lb. The device consists of a steel frame mounted on two wheels, as shown in the illustration. The tanks are of galvanized steel equipped with quick-acting hand pump, filling cocks, air-release and back-pressure valves and pressure

gages (100 lb.). The hood is of sheet steel lined with ¾-in. asbestos board. Each burner is controlled individually and the flame is prevented from striking the pavement directly.

Crowding Engine Eliminated in Gas-Operated Shovel

By a special arrangement of cables and sheaves a separate crowding engine is eliminated in the design of the new gas shovel which the Northwest Engineering Co., Green Bay, Wis., has just released for sale. The shovel is mounted on crawlers and is in the form of an attachment that can be applied to the Northwest crane or dragline by simply laying down the crane boom and mounting the shovel boom. The new shovel, its manufacturers claim, will grade a 30-ft. flat width, 4 ft. below grade, and handle a ¾-yd. dipper without taxing the engine, which develops 50 hp. at 800 r.p.m. As regularly equipped, power is furnished by a gas engine, but where electric current is available motor equipment may be substituted. The operating dimensions of

the shovel are: Width, 9 ft. 8 in.; length of boom, 23 ft.; length of dipper stick, 15 ft. 6 in.; working angle of boom, 40 to 50 deg.

Combined Level and Transit

A combined level and transit, one of the sterling line of instruments, has been developed by the Warren-Knight Co. of Philadelphia. Conversion from one type of instrument to the other, it is claimed, is possible in 10 sec. without the use of detachable parts. The telescope is 13½ in. long and the level vial 5 in. long. The wyes are provided with patent quick-opening lock screws which may be operated without jarring the instrument out of level. For use as a transit the instrument is equipped with a horizontal circle 4½ in. in diameter, graduated to degrees with vernier reading to 5 min. When used as a transit the telescope is carried on trunnions in permanently attached hinged uprights, as shown in the accompanying illustration; when converted into a level these uprights are folded down out of the way against the level bar.

Dump Body for 1-Ton Truck

For use on a 1-ton Ford truck the Griscom-Russel Co., New York City, is manufacturing the Jiffy all-steel dump body, which may be operated without the necessity of the driver leaving his seat. The body has a pivot scale-balance 5 in. in front of the rear axle, eliminating any hoisting device. It is made of No. 10 gage steel, has a capacity of 1½ cu. yd., and weighs 600 lb. The tail-gate opens automatically when the body reaches an inclination

of 45 deg. The overall height from ground is 4 ft. 7 in., making loading easy and avoiding the danger of overturning. The inside dimensions are: length, 72 in.; width, 42 in.; depth, including flareboard, 18 in. The body is attached to the truck chassis by four bolts.

The body and sides are in one piece without seams and a heavy channel-iron subframe is electrically welded to the body. There are no wooden parts in this equipment.

Out-of-the-Ordinary Trade Publications

Brass and Copper Pipe—THE COPPER AND BRASS RESEARCH ASSOCIATION, New York City, has issued, in the form of a wall chart, a house piping plan and table of sizes of pipe to be used under varying conditions of service. One table indicates the properties—weight, diameter, etc.—for brass and copper pipe ranging from ⅛ to 7 in. Other tables show the estimated rate of draft of water for bathroom, laundry, etc., capacities of water piping in buildings, and sizes of supply branches to fixtures.

River Bank Protection—THE WOODS BROS. CONSTRUCTION CO., Lincoln, Nebr., in a 32-page illustrated pamphlet, describes its current-retard system of checking bank erosion and causing the deposit of sediment in front of the attacked or threatened spot. The retards are practically permeable spur dikes composed of masses of trees lashed together and attached by anchor cables to concrete piles buried in the river bed. These piles are of the Bignell type, having pipes embedded in the concrete for water jets which facilitate the sinking of the pile through any loose material. In silt-bearing streams the checking of the current causes sedimentation to begin at once and to increase rapidly as the sand bar builds up. Numerous examples of this protection and reclamation work are described and there is mention also of the use of the Bignell piles in foundation work.

Hydraulic Turbines—The PELTON WATER WHEEL CO., of San Francisco and New York, has issued a 15-page illustrated pamphlet describing the hydro-electric installation at Kern River, Plant No. 3 of the Southern California Edison Co., by Ely C. Hutchinson, vice-president and general manager of the Pelton company. The hydraulic prime-mover equipment for this plant is notable since it comprises two 25,000-hp. vertical turbines operating under a head of 810 ft., the highest-head reaction turbines in the world.

Motor Trucks—THE ACME MOTOR TRUCK CO., Cadillac, Mich., describes seven models of motor trucks ranging in capacity from 2,000 to 12,500 lb. in a 42-page illustrated catalog just issued. Detailed specifications are given for each model and several pages are devoted to body features covering a variety of types. One page is devoted to a tabulation of weights of materials ordinarily hauled by motor trucks.

Business Side of Construction

Facts and Events that Affect Cost and Volume

July Contracts 34 Per Cent Under Preceding Month

Decrease of $63,168,094 from June, 1922—$13,162,857 Greater Than Same Month Last Year

Important engineering contracts awarded in the United States during the month of July totaled $116,670,906, an increase of $13,162,857 or 12½ per cent, over the corresponding period of 1921. The July total for the United States and Canada, however, represents a falling off of $63,168,094, or 34 per cent, from the month preceding. Canadian contracts for July totaled $2,503,000 as against $6,897,000 for June. These figures are compiled from Construction News and involve large engineering contracts only, with a minimum of $25,000 on public works, $40,000 for industrial construction and $150,000 in the case of commercial buildings.

Lettings in the Middle Atlantic states reached $35,438,278 as against $34,652,557 in the Middle West, or nearly the same in each section. These two groups have surpassed the others in numbers and values of contracts let since the beginning of the year; but in only two instances, namely in January and June, has the Middle West exceeded the Middle Atlantic states in values of contracts awarded. July lettings west of the Mississippi fell 44 per cent, and in the Middle West 47 per cent below June.

Federal Government work represented the only classification showing a gain, in July, over the preceding month. Bridge building dropped nearly 50 per cent and industrial construction over 52 per cent during the month.

Business Briefs

Steel and iron output fell off only 5 or 6 per cent in the last two weeks, but the combination of coal and railway strikes will greatly decrease production unless a settlement is soon reached. See Ups and Downs of the Market, this issue.

Business for the week ending July 26 totaled $8,228,000,000, a decrease of 5 per cent from the preceding week, which is customary after the mid-month week.

German mark touched new low, 0.15⅝c.

Liberty bonds continue to advance.

Money can be had for 3@4 per cent on call, 4@4½ up to six months.

Railway equipment buying heavy as result of strikes. Several hundred new locomotives bought, while freight-car orders run into the thousands. New York Central R.R. ordered 150 freight locomotives last week. Illinois Central ordered 1,000 gondola cars.

Seasonal Employment Among Building Trades Workers

Study of 92,300 Cases in New York Reveals Interesting Figures.—Recommendations Made.

Results of an analysis of seasonal employment among the building trade workers in New York City made by the New York Building Congress show that among a total of 92,300 actual cases studied there is an average employment of 83 per cent during the entire year, with the lowest point at about 50 per cent in December and the peak in May, June, July, August, September and October. In many of the trades employment runs 100 per cent during the spring, fall and summer months. Though the congress did not investigate the conditions of employment among all the 150,000-odd building trade workers in New York, it considered that it made a sufficient analysis upon which to base general conclusions and recommendations.

The chart shows the results of the investigation classified according to occupations. The chart indicates the number of cases investigated. Although the congress is aware of the fact that an entire cure for seasonal unemployment is impossible because of weather, opportunity for investment, emergency and will of the owner or

Engineering News-Record Construction Cost Index Number

August, 1922	173.40
July, 1922	169.70
August, 1921	193.07
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 3.7 points higher than last month, due to continued stiffening in prices of steel and lumber. Steel is now $1.70@$1.80, Pittsburgh mill. Cement remains at $2.05 net in Chicago. Lumber is $2 higher in New York. Common labor remains at 44c. as an average for the country. Thus, general construction cost is 10 per cent cheaper than one year ago and 37 per cent under the peak; it is 73 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
July, 1922	118
June, 1922	187
July, 1921	90
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 118 for the month of July, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 118, for July, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN JULY, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$377,000	$1,283,000	$617,000	$209,000	$589,000	$199,000	.....	$3,274,000
Sewers	23,000	250,000	1,202,000	1,468,000	76,000	692,000	$235,000	3,946,000
Bridges	1,470,000	421,000	569,000	452,000	1,127,000	119,000	721,000	4,879,000
Excav. and dredging	.....	22,000	25,000	50,000	223,000	.....	.....	320,000
Streets and roads	1,682,000	8,222,000	4,564,000	9,019,000	5,821,000	3,525,000	703,000	33,536,000
Industrial works	550,000	2,196,000	1,490,000	5,066,000	211,000	1,753,000	350,000	11,616,000
Buildings	4,381,000	18,841,000	3,638,000	16,662,000	2,045,000	4,773,000	494,000	50,834,000
Fed. Gov't work	11,400	2,887,278	1,320,589	1,494,557	1,146,730	239,352	.....	7,099,906
Miscellaneous	50,000	1,316,000	419,000	232,000	75,000	1,577,000	.....	3,669,000
Total	$8,544,400	$35,438,278	$13,844,589	$34,652,557	$11,313,730	$12,877,352	$2,503,000	$119,173,906

speculator, it considers that certain recommendations can be based upon the analysis made. Such recommendations include:

1. Establishment of a wider range of rental period dates.

2. Regulation of government, state, city, religious and educational building construction so that it may come during the low period of employment wherever possible.

3. Regulation of construction of new buildings and additions erected for the owner's prearranged occupancy without regard to investment returns so that it will come during the low period of employment.

4. Encouragement of a plan to begin work on March 1 instead of May 1, thereby bringing labor demand two months ahead of the demand peak.

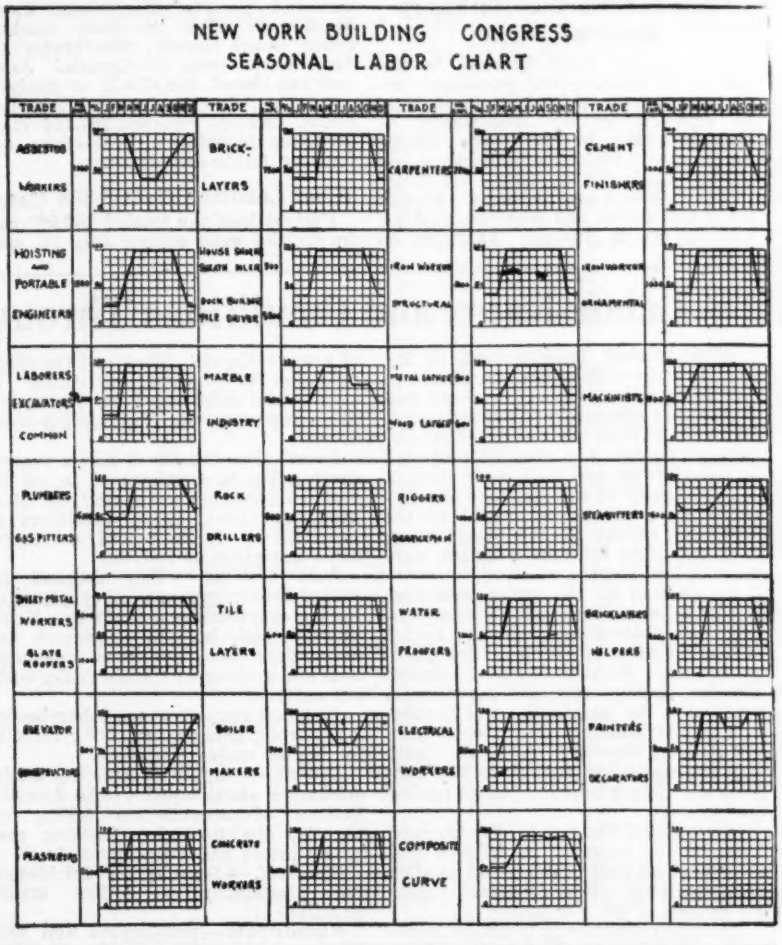
5. Planning maintenance and repair work to come during a season of low demand for labor.

6. Adaption wherever possible of the demand for "inside" and "outside" work to the labor available.

The New York Building Congress would carry into effect its recommendations by distribution of published matter on the points in newspapers, magazines and trade journals and by discussions and resolutions among various civic and fraternal labor organizations.

The Committee on Seasonal Employment, which made the investigation, was composed of Walter Roberts, chairman; Charles E. Mack, Roswell D. Tompkins, Fitz-Henry Faye Tucker, H. H. Watters and Frank L. Glynn.

Bond Market steady last week owing to brighter outlook in strikes and reparations. Brisk demand for municipals, without advances in bid prices; dealers pointing to scarcity in this class.



Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron.—Growing scarcity advances price of No. 2 foundry, 50c. in Pittsburgh; $1 in Philadelphia and $2 in Birmingham, New York, Cincinnati and Chicago. Basic up 50c. in Pittsburgh and Philadelphia and bessemer, 50c. per gross ton in Pittsburgh.

Railway Supplies.—Light rails up 10c. per 100 lb. in Birmingham and $3 per ton, f.o.b. Pittsburgh. Rails (8@45 lb.) in Pittsburgh, $10 per ton cheaper than one year ago.

Pipe.—Cast-iron pipe down 50c. at Birmingham mill and $1.40 in Chicago but rose $2.50 per ton in New York, during month. Wrought pipe prices unchanged despite increased demand. Sewer pipe advanced ½c. per ft. in Atlanta. Price tendency upward, in all clay products, due to fuel situation. Philadelphia and Minneapolis, however, report very slight drop in price of sewer pipe.

Road and Paving Materials.—Asphalt, both in package and in bulk, up $4.50 per ton in Minneapolis. Wood-paving blocks advanced 10c. in New Orleans, due to higher lumber prices. Philadelphia quotes reduction of 32c. per sq.yd.

Sand, Gravel and Crushed Stone.—Both sand and gravel advanced 15c. per cu.yd. in Seattle, due to labor and transportation conditions. Crushed stone, 1½-in., down 40c. per cu.yd. in Montreal.

Lime.—Common hydrated lime quoted at $13.11 as against $12.29 per ton in New York. Atlanta reports advance of 50c. per ton on hydrated finishing and 5c. per bbl., 180-lb. net, on common lump. Brick shortage preventing scarcity of lime. San Francisco, however, quotes common hydrated at $16 as against $18 per ton last month.

Cement.—Higher fuel costs cause mill advances of 10c. at Steelton, Minn.; Leeds, Ala., and Hannibal, Mo. Mill rise reflected in following advances: f.o.b. Duluth, 12c.; San Francisco, 8c.; Minneapolis, 10c.; Atlanta, 16c. and St. Paul, 10c. per bbl. Reductions of 5c. in Atlanta and 10c. per bbl. in Montreal.

Steel.—Steel shapes, plates and bars quoted at $1.70@$1.80, f.o.b. Pittsburgh, as against $1.60@$1.70 per 100 lb., last month. Quotations of $1.70 increasingly difficult to obtain; as high as $1.90@$2 quoted on plates and $2 per 100 lb. on shapes, for immediate deliveries. Curtailment of coal deliveries causing decreased production at mills. Structurals up 15c. in New York warehouses. Blue annealed sheets, base size, up 15c. in New York and 20c. per 100 lb. in San Francisco. Triangle mesh and wire nails higher at mill.

Brick and Hollow Tile.—Despite scarcity and increased demand common brick quoted in New York at $20, wholesale, as compared with $21 per M. one month ago. Philadelphia quotes rise of 50c. per M. but slight drop reported in Pittsburgh. Advances in hollow tile in Chicago, Atlanta, Montreal and Seattle, due to fuel shortage.

Lumber.—Despite declines in buying, price advances exceed reductions throughout the country. Long leaf yellow pine up $2@$3 in New York and down $2 per M. ft. b.m. in Chicago. Yellow pine structural timbers, base sizes, advanced in Minneapolis, Philadelphia, Birmingham and Atlanta; down in Montreal and Dallas. Douglas fir up in Minneapolis and Philadelphia; lower in Denver. Hemlock and spruce up in Philadelphia; down in Denver.

Scrap.—Iron and steel scrap prices weaker. Railroad malleable cast, however, quoted in New York at $12 as against $11 per gross ton.

Explosives.—Average drop of ½c. per lb. on dynamite, over country.

Little Construction Machinery Exported in May

Perhaps the chief interest in the figures of construction machinery exported from the United States in May, as reported by the Department of Commerce lies in the small volume represented. Only 226 units were exported, worth but $376,832. Of these, 196 were hoists and derricks. Except for a few hoists and derricks, nothing was shipped to Europe. As might be expected, Canada, Mexico and Japan appear to offer the best markets. Seven power shovels, nine cranes and four hoists went to Canada. Japan took one shovel, 339,873 lb. of dredging machinery, five cranes and seventeen hoists. Mexico received 207,156 lb. of dredging machinery, one crane and fourteen hoists and derricks.

Coal Loadings Gain 8,338 Cars

Freight loadings totaled 860,907 cars during the week ending July 15, compared with 718,319 for the preceding week, which included a holiday. This represents an increase of 142,588 cars, according to the American Railway Association, or practically the same number as loaded during the week of June 17. Compared with the corresponding week in 1921, an increase of 86,023 cars is shown and a decrease of 81,944 as against the same week in 1920.

Coal loadings amounted to 77,334, an increase of 8,338 cars over the preceding week.

Labor Rates and Conditions Throughout the Country

With marked improvement in the granite and textile situations, over conditions existing a month ago, and settlements effected in the minor manufacturing strikes, the two principal disturbing factors are now concentrated in the railway and coal controversies.

Uncertainty of fuel supplies and impending car shortages, caused by the combined effects of the two strikes, have definitely retarded business, during the last month.

In addition to the strike situation, comes an ever increasing shortage of common laborers as well as skilled building trades mechanics, throughout the country. What little unemployment remains among common laborers is confined to the large centers of population, while building trades employers are making concerted efforts to divert the common labor supply to the outlying districts where it is most needed at present.

Increases of 10c. per hr. for common laborers are reported in Atlanta and Pittsburgh as well as in several smaller municipalities; while Montreal quotes a decrease of 5c. per hr.

The general tendency in all construction trades is toward either stabilization of the present wage scales or actual advances in pay. Hodcarriers in New Orleans, however, have been reduced 10c. per hr., pending settlement of a wage dispute. That, and the slight reduction in Montreal constitute the only wage cuts noted in twenty-one cities reporting to *Engineering-News Record.*

Latest Department of Labor reports show gains in employment in all industries excepting stone, clay and glass products. Local labor conditions as reported by *News-Record* correspondents are given as follows:

New Orleans. — Fair demand for skilled labor; common labor plentiful. No big construction under way. Negotiations with hoisting engineers and hodcarriers have not been concluded. Men are working at the old scale, without contract.

Birmingham.—Common labor becoming scarcer; many men leaving the city for higher wages elsewhere.

Detroit. — Supply of building trades mechanics about equal to the demand. Volume of construction falling off slightly, due to higher building materials prices and wage demands.

Montreal. — Scarcity of bricklayers and plasterers; all other trades plentiful.

Philadelphia.—Bricklayers and pile-drivers scarce; fair supply of other crafts.

Pittsburgh.—Not enough bricklayers and carpenters. Plenty of hodcarriers and common laborers but barely enough hoisting engineers and structural ironworkers.

New York. — The situation in New York is mainly one of a shortage of bricklayers and plasterers. However, construction activities have not been hampered by strikes or serious wage controversies. Slight differences have existed between the two separate and district building laborers' unions in the city, namely, the Independent Bricklayers' Helpers' and Building Laborers' Union and the International Hodcarriers', Building and Common Laborers' Union. The former, with a membership of 17,000, has entered into agreements with the Building Trades Employers' Association, to maintain the hodcarriers' wage schedule of 87½c. per hr. for the balance of the year. This organization is not affiliated with the American Federation of Labor nor is it opposed to that body. The International Union, however, is a part of the Federation, covering the same trades and at the same wage rates. Cement and concrete laborers continue under the 1921 schedule, 81½c. per hr., with a plentiful supply of men. Pick and shovel men, although unionized, have entered into no agreements with the employers and operate at the rate of 60c. per hr. Non-union laborers receive as low as 44c. per hour.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	+$0.30
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.15@.20
Boston	.90	.90	.90	.60	.90	.90	.55
Cincinnati	1.25	.95	.95	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	1.04	.60	.91	1.10	— .57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81½	1.00	1.03½	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.....
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56½@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	+.90	.65	.50	.35	.50	.55	— .25@.30
New Orleans	1.00	.85	.90	—.50	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.44@.60
Pittsburgh	1.30	1.12½	1.00	.80	1.00	1.00	+.50@.60
St. Louis	1.25	1.12½	1.12½	.85	1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.25@.35

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$25.50†**	$24.50
Northern Basic	**26.52†**	19.00
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*26.52†*	22.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**31.66†**	30.26
BIRMINGHAM		
No. 2 Foundry, (silicon 2.25@ 2.75)	**20.50†**	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@ 2.75 sil.)	**28.32†**	22.50
Virginia No. 2 (silicon 2.25 @ 2.75)	**29.74†**	29.74*
Basic	**26.00†**	21.50†
Grey Forge	**26.00†**	21.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75@ 2.25)	**24.50†**	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**27.17†**	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**25.50†**	22.00
Basic	**25.50†**	20.50
Bessemer	**25.50†**	22.50

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb.	**35.00**	45.00	**1.70***	1.60@1.70*
Light rails, 12 to 14 lb.	35.00	45.00	**1.70***	1.60@1.70*
Light rails, 25 to 45 lb.	**35.00**	40.00	**1.70***	1.60@1.70*
Rerolled Rails	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted. Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.44
St. Louis, Red Oak*	.97	1.17
St. Louis (creosoted)	No. 1, $0.86;	No. 2, $0.96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ½-in. and larger	$2.25@2.35	$3.00	$2.55	$3.00	$4.10	$2.80
Track bolts	3.00@3.50	4.00	3.65	4.25	5.10	3.80
Standard section angle bars	2.40	2.75	2.40	3.00	4.00	3.00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	71	58½	⅜ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 4	42½	29½
6 to 8	65	51½	4½ to 6	42½	29½
9 to 12	64	50½	7 to 12	40½	27½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	⅜ to 1½	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York				
	Birmingham Mill	Current	One Year Ago	Chicago	St. Louis	San Francisco
4 in.	*$41.50*	**$58.30**	$53.30	*$49.20*	$43.70	$55.00
6 in. and over	*37.00*	**53.30**	48.30	*45.20*	39.70	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.00	$80.00	60.00	$76.50	65.00
5	80.00	90.00	.....	80.00	97.75	84.00
6	100.00	115.00	140.00	100.00	127.50	110.00
8	150.00	185.00	200.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.16	$0.087	.....	.....	$0.12	$0.12	.....
4	.16	.087	$0.09	$0.0875	.12	.15	$0.18
5	.22	.1305	.1125	.....	.18	.18	.165
6	.22	.1305	.135	.1225	.18	.21	.25
8	.37	.203	.225	.20	.28	.30	.35
10	.54	.3045	.2925	.28	.42	.42	.....
12	.70	.3915	.3825	.36	.54	.54	.80
15	1.20†	.522	.5625	.52	.72	.90	.....
18	1.65†	.725	.765	.68	1.00	1.32	.....
20	2.10†	.87	....	.92	1.20	.....	.....
22	2.70†	1.16	.....	.....	1.60	.....	.....
24	3.05†	1.305	1.50	1.20	1.80	2.16	2.40
27	4.70†	2.34	....	2.00	3.75†	3.00	.....
30	5.20†	2.59	....	2.45	4.75†	3.60	.....
33	6.70†	3.51	....	3.00	5.50†	.....	.....
36	7.70†	4.00	....	3.25	6.00†	.....	.....

	3	5	8	12	24	36
Boston	$0.105	$0.1575	$0.245	$0.4725	$1.575	$4.408
Minneapolis	.....	.....	.40	*.72*	*2.55*	*5.66* †
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.32½	.65†	2.34†	.....
Los Angeles	.11*	.165*	.275	.495	1.65	.....
New Orleans	.....	.106	.27	.459	1.755†	.....
Cincinnati	.096	.144	.224	.43	1.44	4.382†
Atlanta	**.09***	**.135**	**.22**	**.375**	**1.45**	.....
Montreal, *delivered*	.30*	.45*†	.70	1.35	4.50†	.....
Detroit	.099	.1485	.231	.4455	1.935	5.125†
Baltimore	.1225	.2275	.35	.6870	2.29	5.23
Kansas City, Mo.	.15*	.21*	.335	.60	2 41	4.74
Philadelphia	.105	.1575	*.245*	*.4725*	*1.575*	*3.5875*†

*4-in., 6-in., 9-in., respectively. †Double Strength.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0.05	$0.05½
New York, 65% asphalt (at terminal)	.045	.05
New York, binder (at terminal)	**.0575**	.06½
New York, flux (at terminal)	**.055**	.05½
New York, liquid asphalt (atterminal)	.06	.07
St. Louis, 30-50% asphalt (*f.o.b.*) *Wood River, Ill.*	.05	.02½*
Chicago, 40-50% asphalt	**.05½**	.06
Chicago, 60-70% asphalt	**.05½**	.06½
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (dock I) (*Mexican*)	$17.50	$13.00
Boston (*Mexican*)	18.50	14.00
Chicago (*Standolind*)	20.35	14.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50*	13.00*
Dallas, (*Texas*)	35.00	27.00
Seattle "*D*" *grade* (*California*)	23.75	13.00†
Denver (*California*)	40.00	....
Minneapolis *f.o.b. Twin Cities* (*Mexican*)	33.50	28.00
St. Louis (*Mexican*)	22.35	14.00
Baltimore (*Mexican*)	18.00	13.00
Los Angeles, *at factory, Bakersfield* (*California*)	22.50	15.00
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	22.00	16.50
Detroit (*Mexican*)	19.00	15.00
Cincinnati (*Mexican*)	32.00	28.00
Maurer, N. J. (*Trinidad and Bermudez*)	28.50	26.50
Maurer, N. J. (*Mexican*)	18.50	16.50
Philadelphia (*Mexican*)	18@20	13.00
Kansas City, *petroleum*	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$131.75 per M
Chicago	About 4x8x4 dressed	3.20 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3.35 sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	1.70
New Orleans	3½	16	1.90
New Orleans	4	16	2.10
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	3.48

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.25	$1.75	$2.25	$1.00	$1.25
Denver	1.75	2.00	1.75	1.80	0.75	1.60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, *per ton*	1.25	1.45	1.30	1.45	1.10	1.60*
Seattle	1.25	1.50	1.25	1.50	1.25	1.50
Dallas	2.25	3.50	2.25	4.00	2.25	3.00
Minneapolis	1.50	2.00	1.50	....	1.00	1.00
Cincinnati	1.87½	2.25	1.87½	2.25	1.43	1.69
San Francisco	2.25	2.25	2.25	2.50	1.50	1.50
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½	....	1.35	1.35
Los Angeles, per ton	1.50†	1.45†	1.50†	1.45†	1.35†	1.30†
Atlanta, per ton	1.85	2.35	1.85	2.25	1.15	1.35
Detroit	2.00	2.25	2.00	2.25	2.00	2.25
Baltimore, per ton	1.40	1.40	1.60	1.60	2.00	.70
Montreal, per ton	1.25	1.50	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.28	1.60‡
Philadelphia	1.35	....	1.60	....	1.60	....
Kansas City	2.00	....	2.00	....	1.20	....

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$1.90@2.00
Chicago	1.60	2.50	1.60	2.50
St. Louis *delivered*	1.65	1.60*	1.65	1.60*
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.25	2.25	2.50
Boston, *delivered*	3.00*	3.00*	3.00*	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	1.25	2.10	1.40
Denver	3.50	....	3.50	....
Seattle *delivered*	3.00	3.00	3.00	3.50
Atlanta	1.90*	2.25*	1.90*	....
Cincinnati *delivered*	1.75	2.06	1.75	2.06
Los Angeles	1.75*	.90*	1.85*	1.00*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	*1.50**	2.00*	2.00*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.70*	....	1.55*	....
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	*0.75*	0.75	....	0.25
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.17	$13.11	$3.63½*	$2.75@$3.14½*
Chicago	18.00	....	....	1.40†
St. Louis	23.20	20.00	2.35†	....
Boston	23.00	19.00	3.30†	3.00†
Dallas	25.00	....	....	2.50†
Cincinnati	15.10	12.50	10.75‡	12.50‡
San Francisco	22.00	*16.00*	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle *paper sacks*	24.00	....	2.80†	....
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.00†	1.80†
New Orleans	....	17.25	1.75†	....
Philadelphia	13.00	12.00	10.50‡	9.50‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	1.87
Boston (Rosendale) per bag	.80	0.95@1.05
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40@2.50	$2.60@2.70
New York, alongside dock to dealers	2.10	2.10	2.10
Jersey City, del. by truck	2.28	2.28	2.89
Boston	2.50	2.50	2.86
Chicago	2.05	2.05	2.17
Pittsburgh	2.09	2.09	2.17
Cleveland	2.31	2.31	2.43
Detroit	2.33	2.33	2.43
Indianapolis	2.26	2.26	2.43
Toledo	2.33	2.33	2.49
Milwaukee	2.22	2.22	2.39
Duluth	2.14	2.04	2.10
Peoria	2.26	2.26	2.45
Cedar Rapids	2.33	2.33	2.51
Davenport	2.28	2.28	2.47
St. Louis	2.20	2.20	2.90
San Francisco	2.71	2.63	3.09
New Orleans	3.20	3.20	3.20
Minneapolis	2.39	2.29	2.41
Denver	*2.85*	2.90	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.60
Atlanta	2.50	2.34	2.75
Cincinnati	2.39	2.39	2.57
Los Angeles	3.30	3.30	3.21
Baltimore, del. by truck	2.50	2.50	3.58
Birmingham	2.10	2.10	3.05
Kansas City	2.40	2.40	3.20
Montreal	*2.78*	2.88	2.75
Philadelphia	2.31	2.31	....
St. Paul	2.39	2.29	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.80	Mason City, Ia.	$1.95
Universal, Pa.	1.85	Hudson, N. Y.	2.00
Steelton, Minn.	1.95	Leeds, Ala.	1.95
Fordwick, Va.	1.95	Hannibal, Mo.	1.95
Mitchell, Ind.	1.95	Lehigh Valley District	1.90
LaSalle, Ill.	1.70	Kingsport, Tenn.	1.95
Iola, Kan.	1.95	Richard City, Tenn.	1.95

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.74	$0.95	$0.81	$1.15	$1.15
049	28	.94	1.23	1.04	1.46	1.48
068	35	1.14	1.48	1.26	1.80	1.80
093	45	1.46	1.91	1.61	2.30	2.32
126	57	1.80	2.35	1.99	2.86	2.87
153	68	2.14	2.81	2.37	3.40	.....
180	78	2.46	3.22	2.73	3.93	.....
245	103	3.24	4.25	3.59	5.15	.....
287	119	3.75	4.90	4.15	5.96	6.01
336	138	4.35	5.69	4.82	7.32	.....
395	160	5.04	6.60	5.58	8.00	.....
		PAVING				
036P	17	$0.56	$0.72	$0.62	$0.88	.....
053P	24	.79	1.02	.87	1.24	.....
072P	31	.99	1.29	1.10	1.57	.....
097P	40	1.28	1.67	1.42	2.02	.....
049R	24	.79	1.02	.87	1.24	.....
067R	31	.99	1.29	1.10	1.57	.....
089R	40	1.28	1.67	1.42	2.02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$17.50	$20.39	$21.25	$23.87	$25.50
26BB	2.5	17.50	22.00	22.75	26.21	27.56
25BB	3.0	20.00	.....	27.10	.....	30.71
24BB	3.4	21.50	26.33	29.25	27.90	33.16
22PO	4.33	21.50	31.00	31.75	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.60@1.70	$1.85	$2.73	$2.60	$2.47½	$3.50	$2.55
⅝ and larger	1.65@1.75	1.90	2.78	2.65	2.52½	3.55	2.60
¾ and larger	1.70@1.80	1.90	2.83	2.70	2.57½	3.60	2.65
⅞ and larger	1.85@1.95	1.95	2.88	2.85	2.72½	3.75	2.80
1 and larger	2.10@2.20	1.95	2.93	3.10	2.97½	4.00	3.05

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1.70	$2.25	$3.25	½	$1.95	$2.50	$3.50
⅝ in.	1.75	2.30	3.30	¾	2.20	2.75	3.75
⅞	1.80	2.35	3.35		.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	*$3.50*	$24.60	$18.40	$40.00†	$45.00†
New York (at dock)	*20.00*	21.00	15@15.50	.....	.....
Chicago	11.00	11.00	12.00	34.00	42.00
St. Louis, salmon	14.00	14.00	17.00	.....	28.00
Denver, salmon	12.00	12.00	14.00	.....	.....
Dallas	11.15	11.15	12.50	no market	
San Francisco	15.00	15.00	18.00	.....	.....
Los Angeles (del.)	15.00	15.00	15.50	(not used)	
Boston (del.)	16.00	16.00	18.00	42.00†	47.50†
Minneapolis (del.)	17@18	17@18	17.00	.....	43.00
Kansas City	14.50	14.50	15.50	.....	.....
Seattle	14.00	14.00	14.00	44.00	.....
Cincinnati	15.00	15.00	19.00	41.00	36.50
Montreal	16.00	16.00	18.00	.....	68.00
Detroit (del.)	16.50	16.50	16.25@18	36.50	39.50@41
Baltimore (del.)	20.00	20.00	25.00	36.00‡	.....
Atlanta	11.00	11.00	10.00	.....	.....
New Orleans	12.50	12.50	14.50	.....	.....
Birmingham	12.00	12.00	12.00	.....	.....
Philadelphia	1750@18.50	17@18	16.50@17.50	.....	44.00
Pittsburgh (del.)	*16.00*	16@18	.....	.....	.....
Cleveland	14.00	14.00	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.11120	$0.12320	$0.0741	$0.10	$0.0635	$0.108	.....
6x12x12	.16670	.1642	.0190	.....	.08	.156	.....
8x12x12	.20840	.219	.3900	.10	.12	.244	$0.17890
10x12x12	.....	.....	.7320	.....	.16	.....	.21050
12x12x12	.....	.....	.9790	.....	.185	.....	.27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.94	$0.177	$0.244
Minneapolis (f.o.b. cars)	.076	.12475	.220
Minneapolis (delivered)	.086	.14025	.248
Cincinnati	.0670	.1263	.175
Kansas City	.085	.167	.270
Denver	.08	.145	.21
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.095	.176	.22
New Orleans	.12	.23	.36
Detroit (delivered)	.070	.135	.225
Montreal	.09	.18	.30
Baltimore	.14	.25	.39
Atlanta	.0776	.1453	.....
Dallas	.115	.....	.....
Birmingham	.10	.17	.....
Pittsburgh (del.)	.068	.128	.179
Cleveland	.065	.143	.....

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.70@1.80	$1.95	$2.83	$4.00	$2.57½	$2.68	$3.10
Channel, 3 to 15 in.	1.70@1.80	1.95	2.83	4.00	2.57½	2.68	3.10
Angles, 3 to 6 in., ¼ in. thick	1.70@1.80	1.95	2.83	4.00	2.57½	2.68	3.10
Tees, 3 in. and larger	1.70@1.80	1.95	2.83	4.00	2.57½	2.68	3.10
Plates	1.70@1.80	1.95	2.86	4.00	2.57½	2.68	3.10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York, Current	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.40	$3.70	$4.40	$3.10	$3.09½	$4.25	$5.50
CONE HEAD BOILER							
½ in. and larger	2.50	3.70	4.50	3.20	3.19½	4.35	5.65
⅝ and ¾	2.65	3.86	4.65	3.35	3.35½	4.50	5.80
⅞ and 1	2.90	4.10	4.90	3.60	3.59½	4.75	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.40@2.50	$2.10	$3.90	$5.00	$3.25	$4.95
Cut	2.25	5.50	5.65	7.75	....	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2.10	$2.55	$3.00	$1.90	$2.35	$2.80
No. 2 grade	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $5.75

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.40@$2.60	$3.62½	$3.75	$4.35	$3.78
No. 12	2.45@2.65	3.67½	3.80	4.40	3.83
No. 14	2.50@2.70	3.72½	3.85	4.45	3.88
No. 16	2.70@2.90	3.82½	3.95	4.55	3.98
Black					
*Nos. 18 and 20	3.00@3.25	3.70	4.30	5.45	4.15
*Nos. 22 and 24	3.05@3.30	3.85	4.30	5.50	4.20
*No. 26	3.10@3.35	4.00	4.35	5.55	4.25
*No. 28	3.15@3.40	4.30	4.45	5.65	4.35
Galvanized					
No. 10	3.15@3.35	4.30	4.45	....	4.35
No. 12	3.25@3.50	4.40	4.55	5.60	4.45
No. 14	3.25@3.50	4.40	4.55	5.60	4.45
Nos. 17 to 21	3.55@3.80	4.60	4.85	5.90	4.75
Nos. 22 and 24	3.70@3.95	4.85	5.00	6.05	4.90
*Nos. 25 and 26	3.85@4.10	5.00	5.15	6.20	5.05
*No. 28	4.15@4.40	5.30	5.45	6.50	5.35

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	$0.91	$0.80	$1.01	$0.75

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current Dry or In Oil	Yr. Ago Dry or In Oil
	Dry	In Oil	Dry	In Oil		
100-lb. keg	12.50	14.00	13.00	14.50	12.50	13.00
25 and 50-lb. kegs	12.75	14.25	13.25	14.75	12.75	13.25
12½-lb. keg	13.00	14.50	13.50	15.00	13.00	13.50
5-lb. cans	15.50	17.00	16.00	17.50	15.50	16.00
1-lb. cans	17.50	19.00	18.00	19.50	17.50	18.00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28.00	$31.00	$31.00	$33.00
3x6 and 8	28.00	31.00	31.00	34.00
4x4-6 and 8	28.00	31.00	32.00	35.00
3x10 and 12	28.00	31.00	32.00	36.00
3x14	32.00	33.00	34.00	36.00
4x10 and 12	28.00	31.00	32.00	35.00
4x14	32.00	33.00	34.00	36.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$30.00	$33.00	$35.00
6x14	32.00	35.00	37.00
8x10	30.00	33.00	35.00
8x14	32.00	35.00	37.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38.00	$39.00	*$47.50*	*$48.50*
3x10 to 10x10	43.00	44.00	*44.00*	*46.00*
3x12 to 12x12	46@47	47@48	*47.00*	*49.00*
3x14 to 14x14	50@52	51@53	*52.00*	*54.00*
3x16 to 16x16	55@57	56@58	*56.00*	*58.00*
3x18 to 18x18	65.00	66.00	*63.00*	*65.00*
4x20 to 20x20	75.00	76.00	*73.00*	*75.00*

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$52.00	$55.00	$45.00	$54.00	$52.00
Seattle	.....	23.00	.....	.....	.....	23.00
New Orleans	30.00	.....	.....	.....	35.00	.....
Baltimore	36.45	.....	.....	.....	38.50	.....
Cincinnati	39.00	50.00	.....	.....	40.00	64.00
Montreal	*50.00*	50.00	35.00	38.00	78.00	50.00
Los Angeles	.....	44.00	43.00	.....	.....	44.00
Denver	.....	*36.25*	*36.25*	*36.25*	.....	*37.25*
Minneapolis	46.00	41.00	40.00	.....	49.00	41.00
Atlanta	35.00	.....	.....	.....	40.00	.....
Dallas	37.50	.....	.....	.....	*38.00*	.....
Kansas City	33.00	34.00	.....	.....	36.00	35.00
Birmingham	28.00	.....	.....	.....	33.00	.....
Philadelphia	38.00	39.00	43.00	48.50	47.00	39.00
Detroit	41.25	44.00	.....	.....	47.00	46.00
St. Louis	35.00	.....	.....	.....	38.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47.00	$48.00	$32.00	$45.00	$48.00
Seattle	.....	*16.50*	.....	.....	*16.50*
New Orleans, at mill	70.00	.....	.....	37.00	.....
Baltimore	35.00	.....	.....	36.45	.....
Cincinnati	62.50	80.00	.....	33.50	.....
Montreal	39.50	*45.00*	*27.00*	*45.00*	45.00
Los Angeles	.....	37.00	36.00	.....	43.00
Denver	.....	*33.25*	*33.25*	.....	33.75
Minneapolis	45.50	38.25	36.25	43.75	38.25
Atlanta	22.00	.....	.....	26.00	.....
Dallas	37.50	30.00	.....	40.50	.....
Kansas City	35.00	34.50	.....	20.00	31.00
Birmingham	25.00	.....	.....	28.00	.....
Philadelphia	31.00	37.50	44.00	33.00	37.50
Detroit	42.75	35.00	.....	40.25	38.75
St. Louis	36.00	.....	.....	35.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft to contractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4.50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.65@ 1.85	$2.00	$2.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri Rive:
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.17½
New York	.17	Los Angeles	.16½
Chicago	.19	Seattle	.18
Minneapolis	.19½	St. Louis	.21
San Francisco	.17	Montreal	.30
Atlanta	.20½	Detroit	.19
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	.18½
Dallas	.29	Birmingham	.20½
Philadelphia	.18½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	*$0.29*	*$0.32*
Boston	.24	.275
Kansas City	.24	.2750
Seattle	*.175*	*.195*
Chicago	.2450	.2750
Minneapolis	*.2092*	*.2295*
St. Louis	.2475	.2775
Denver	*.1775*	*.2075*
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	*.2525*	*.2825*
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	*.195*	*.235*
Birmingham, *delivered*	.155	.175
New Orleans	*.2675*	*.3025*
San Francisco	.195	.235
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$11.50	$11.50	$12.00
Stove plate	12.50	12.00	13.50
No. 1 machinery cast	1.,.00	16.50	14.50
Machine shop turnings	7.00@7.50	4.00	5.00
Cast borings	7.00@10.00	5.50	6.75
Railroad malleable cast	12.00	12.50	10.25
Re-rolling rails	11.50@12.00	13.00	15.00
Relaying rails	28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6.75	$5.50	$8.55
⅝	6.30	5.05	8.25
¾	6.15	4.90	8.30

Pittsburgh base in lots of 200 kegs or more $2.50@2.60.

Engine
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